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AN

# APPENDIX

To the FIRST PART of the

## ENQUIRY

INTO THE

Nature of the Human Soul,

WHEREIN

The Principles laid down there, are cleared from some  
Objections; and the Government of the Deity in  
the material World is vindicated, or shewn not to  
be carried on by *Mechanism* and *second Causes*.

---

By the AUTHOR of The Enquiry into the Na-  
ture of the Human Soul.

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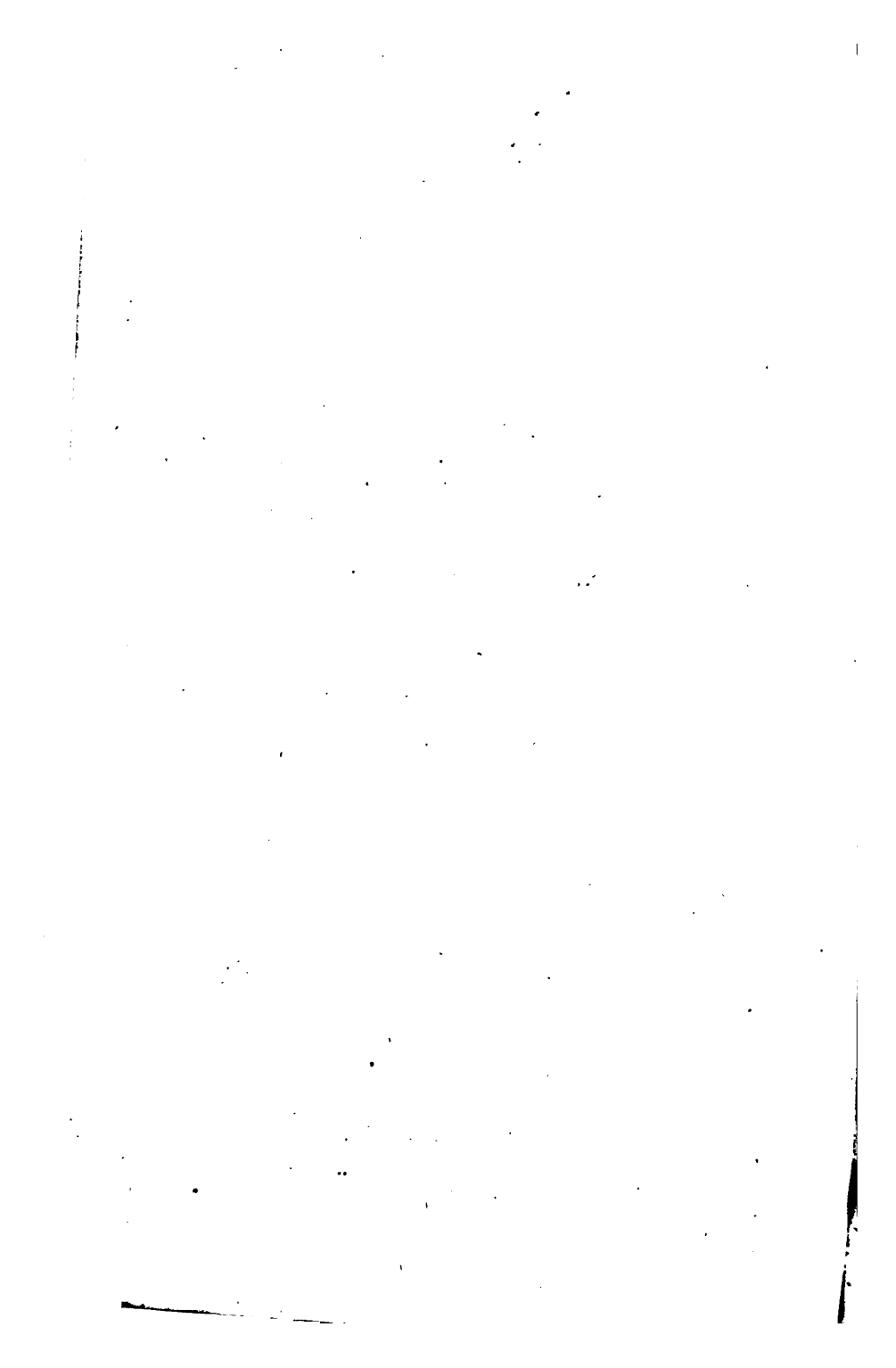
*Quicquid nos meliores beatioreque facturum est, aut in aperto,  
aut in proximo, posuit natura.*  
Seneca.

---

L O N D O N :

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To JOHN WILKES, of Aylesbury, in the County of Bucks, Esq;

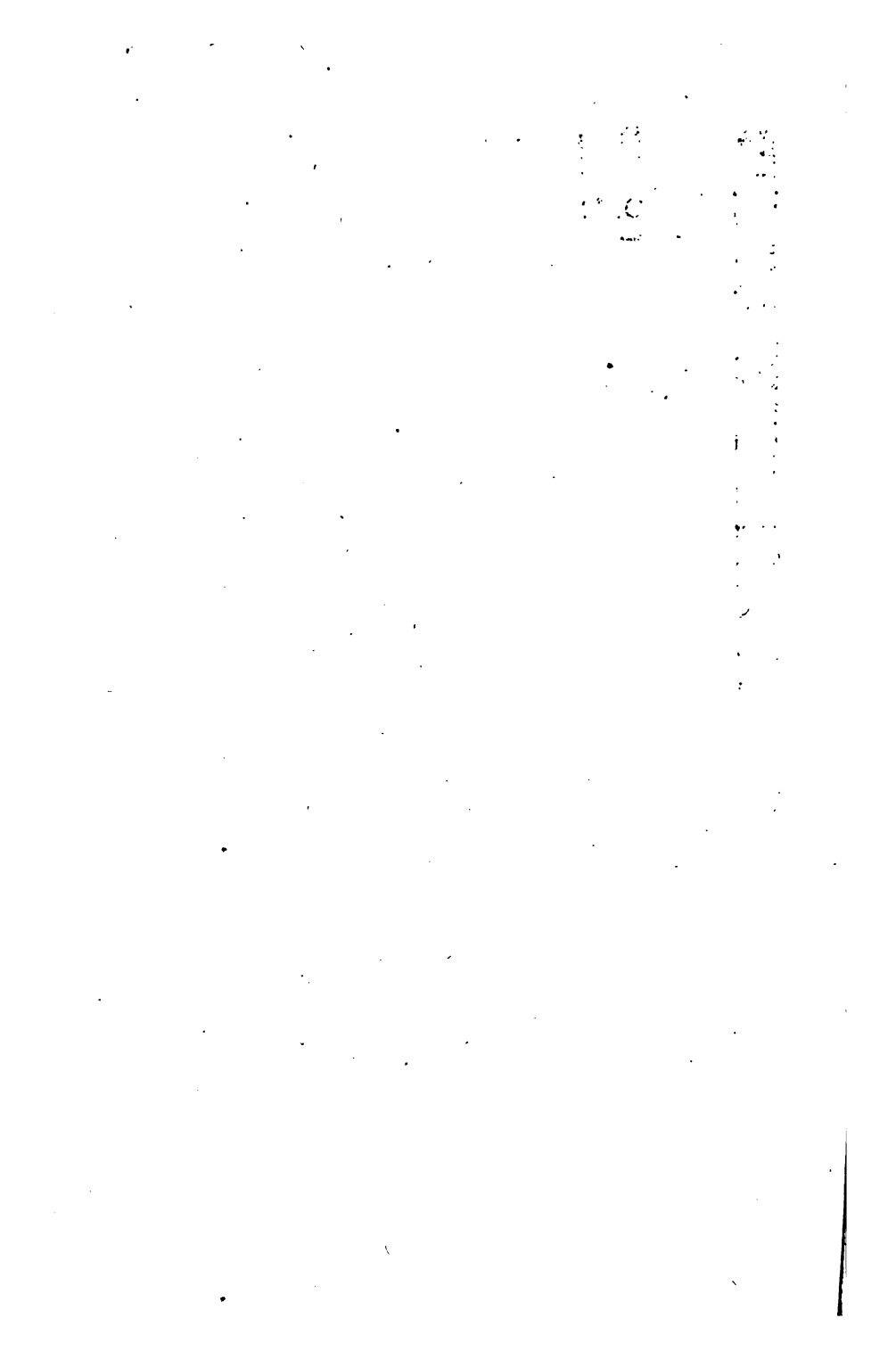
S I R,

THE subject of our conversation in the *Capuchine's* Garden at *Spaw* in the summer of the year 1745, lies still by me in the dress in which it was at first put. I have not leisure at present to prepare it for public view. In the meantime I send you the following sheets as a token of my sincere respect. It is with pleasure I think on the time we spent so agreeably together, and am,

Sir,

*your most obedient*

*humble servant.*



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[ 1 ]

A N  
A P P E N D I X

To the FIRST PART of the  
E N Q U I R Y  
I N T O T H E  
Nature of the Human Soul.

---

S E C T I.

*That all matter, as a solid impenetrable substance, makes equal resistance to a change of its state of rest or motion : or that all bodies resist in proportion to their quantities of solid matter.*

**T**HAT the reasonings in the second Part of the Enquiry into the nature of the human soul, may have their full force, it is requisite that the principles laid down in the first Part, be called to mind, and kept in view. What is to be said in the second Part, supposes these

B principles

principles firmly established, and unexceptionable. But as some things have been lately published, which tend to weaken them, a curious and exact reader will not be dissatisfied to see such doubts carefully examined here. In endeavouring to clear up these points, I may perhaps say something, to prevent other scruples, which might be raised. The subject is of the most serious nature, and it concerns all men to know what they have to trust to, in a matter of such importance ; as far as *reason* and philosophy can inform us.

II. It may be remembered that the *inactivity of matter* was there asserted, and endeavoured to be proved, by many different reasons ; and therefore that *all matter*, without exception, as a solid, impenetrable substance, necessarily resists every change of its present state, of rest, or motion ; because from this resistance it is of use in the material universe, which otherways it could not be. In consequence of this principle, matter was denied to have any sort of *active power*. And if this foundation be not strictly true, I own the subsequent conclusions,

I
fions,

sions, as being deduced from it, must be very precarious. And that it is not true, is pretended to be shewn from various considerations. The first of which follows.

III. Since all matter resists a change of its state of rest or motion, the quantity of matter in bodies is known by this resistance, or by their *vis inertia*; that is, by the force required to move them, or stop them when in motion. With respect to this it is said,  
 “ If the solid uncompounded particles,  
 “ void of pores, of equal bulk, have their  
 “ *inertia* equal, then this must be accurately true [that their *inertia* is proportional to their quantity of solid matter :]  
 “ But if matter be of kinds so different  
 “ from each other, that the solid elementary particles of the one, have a greater  
 “ *inertia*, than the equal, solid elementary  
 “ particles of the other ; then it is only  
 “ when we compare those of the same  
 “ kind, that we can affirm the *inertia* to  
 “ be proportional to the quantity of matter.  
 “ And such different kinds of matter may  
 “ exist, for ought we know.” (a)

(a) Account of Sir *Isaac Newton's* Philosophical Discoveries. Page 100.

IV. The design of writing thus, is to suggest that resistance to a change of its state, is not essential to matter, if some kinds of it may resist less, and some kinds more. It is therefore, rather a surmise artfully thrown in the way, than any real argument; and no notice is taken of the reasons to the contrary: yet as it may afford others a pretence of doubting, I shall beg leave to observe, That, without going to the solid elementary particles of matter, it might have been said all at once, If equal solid bodies, of any bulk, void of pores, be of kinds so different, that the one has a greater *vis inertiae* than the other, then we cannot be sure that equal quantities of matter make an equal resistance to a change of state. Which I really think is only saying, If the equal resistance of all matter to a change of its state, asserted by some men, be not true; then it is not true. Such a way of doubting is very universal, and will hold against any proposition in *Euclid*.—The elementary particles of matter are brought in here, because we cannot see them, and there is room for dispute when  
I
they

they are referred to : but whatever different resistance we suppose them to have, the same will be applicable to bodies consisting of an equal number of these differently resisting elementary particles ; or to equal quantities of these different matters.

V. The resistance, or *vis inertiae* of solid, impenetrable substance, arises from the solidity of it : and as it is absurd to suppose the solidity of one part, void of pores, greater than the solidity of another equal part, also void of pores ; so it is absurd to suppose the resistance of one solid part, greater than the resistance of another equal solid part. For if solidity causeth resistance, then equal solidity must cause equal resistance : and if solidity doth not cause resistance, solid, impenetrable substance could not resist at all. And if it did not resist at all, it would not be solid, but only a shadow of solidity. Thus, there is no *medium* between a body's making no resistance at all to a change of its state, and making a resistance proportional to its solidity, or the quantity of matter in it.

VI. With respect to this I would ask, If solidity be not the cause of resistance in bodies, how it comes that bodies resist at all? or from what other cause resistance can proceed? No man on earth, I think, can assign any other cause of resistance than solidity.—Then if solidity be the cause of resistance, I would ask a reason, Why equal solidity should not make equal resistance? or why one solid body should not resist as much, as another equal solid body? It would have been proper to have considered these questions, before an objection was raised: for if no reason can be assigned, or so much as imagined, the author here endeavours to raise an objection, without being able to found it any where, or to give a reason of objecting. This I leave to be considered by men of judgment.— But farther; If body made no resistance at all to a change of its state, it could bear no force or pressure to be made upon it; because it would be moved without any force impressed, or again stopt, without communicating any force, or motion to other bodies, It could not so much as bear the contact



contact of resisting matter, but fly from that, without being touched ! and stop again without touching it ! Does any man understand this motion, or this rest ? Yet these are plain consequences of body's making no resistance at all. But they are contradictory too. Body as a solid extended substance occupies space, and admits no other body into the same space, since two bodies cannot be in the same space at the same time ; and such a body, pressed on all sides, would make an insurmountable resistance to any natural force, and bear an infinite pressure, without yielding : for it could not be reduced to nothing, nor brought into less dimensions, except by infinite power, being by supposition perfectly solid. And if matter of this kind were engaged in any natural operation, with other matter, in an animal or vegetable body, or in the ground which we labour, or put to any other use ; it would, by its equal solidity, resist as much as it was resisted : or *action and re-action* between it and other matter would be equal. And as this equality of resistance in all cases, proceeds from its equality of solidity ; it again appears,

that there is no *medium* between a body's making no resistance at all to a change of its state, and resisting in proportion to its solidity.

VII. But what is gained by such surmises as these? As long as matter is allowed to make any resistance at all to a change of its state, tho' ever so little; it could never become a self-moving substance; since it could not both resist motion, and move itself, at the same time, more than it could be said to do a thing, and not do it at once. And if it be supposed to make no resistance at all to a change of its state, it could be of no use in the material world, as having no force to stop, or to impel other matter. A *subtile, elastic fluid* of such unresisting matter, could never cause *gravity*, by impelling bodies to a center, nor produce *the chief Phenomena in nature*, as is supposed. It is not right to depreciate matter in one case, and exalt the effects of it in another. Or if some sorts of matter had but one half, or one third the resistance of other matter; a double, or a triple quantity of it would be necessary, to produce but an equal effect :  
which

which is no compend in the action of matter upon matter. I cannot see what is gained by such suggestions ; unless it be to perplex an inattentive reader, or give a handle of chicane to those, who are vain of not yielding in any case.

VIII. If it should be said, God could make equal quantities of solid matter, that should resist unequally ; for this objection runs to the extent of possibility, when it is said, *for ought we know* : It is answered, Not without making the nature of solid and resisting substance different from what it is. Matter resists as it is solid ; and equal solidity must resist equally, except we should suppose it reduced to less dimensions by pressure, and the substance destroyed ; which no created power is able to perform. And if God changed the nature of solid impenetrable substance, what is applicable to it now would not be applicable to it then. Since resistance proceeds from solidity, and solidity consists in being *void of pores*, as is allowed in the objection ; it is as absurd to suppose two different degrees of resistance, arising from the same solidity, as to suppose

pose two different sorts of solidity arising from the same property of *being void of pores*. The power of the Deity is not to be brought into such suppositions. We might as well suppose, that the same quantity of matter, might at one time make a greater resistance, and at other times a less. If I should ask, if God could make such a sort of solid matter, as should not resist at all, nor bear any pressure? It would be asking, if God could make such a sort of solid matter, which should not be solid? This would deserve no answer.

IX. But let me be permitted to ask, If this less resisting matter would gravitate equally, or be equally heavy, as the ordinary matter? To allow this would be to allow, that it resisted equally as other matter. Yet it is elsewhere said in the same work, "Gravity being found by so many  
 " experiments and observations, to affect  
 " *all the matter of bodies equally*, we have  
 " hence the more reason still to conclude  
 " its universality; since it appears to be a  
 " power that acts not only at the surfaces  
 " of bodies, and on such bodies as are re-  
 " moved

“ moved at a distance from them, but to  
 “ *penetrate into their substance*, and into  
 “ that of *all other bodies*, even to their very  
 “ centers ; to affect their *internal parts*,  
 “ with the same force as their external ;  
 “ to be obstructed in its action by no in-  
 “ tervening body, or obstacle ; and to ad-  
 “ mit of no kind of variation in the same  
 “ matter, but from the different distances  
 “ only from the body to which it gravi-  
 “ tates.” (b) Now since gravity is so uni-  
 versal, such unresisting matter, if it existed,  
 would gravitate as much as other matter ; it  
 would require as much force in any *subtile*  
*fluid*, to urge it downward, and, if it fell  
 from an equal height, would have an equal  
 force, or *impetus* in its fall, as other matter :  
 that is, it would make an equal resistance to  
 a change of its state, as the common mat-  
 ter. For there are not two sorts of gra-  
 vity. This is contrary to the supposition  
 of two sorts of resistance. We measure  
 the quantity of matter in all sorts of bodies,  
 by their gravity or weight ; and therefore  
 by their resistance ; unresisting matter could  
 have no weight.—It will be of use to

(b) Page 276.

what

what follows below, to remember that this place is very exprefs against any *variation* in gravity, except from the different distances of the body toward which matter gravitates. It is likewise very plainly shewn here, that gravity cannot be owing to the action of matter upon matter, since it *penetrates the solid substance of bodies*, and affects their *internal parts*, with the same force as their external; which matter could not do. There is no penetration of parts in impenetrable substance : otherwise we lose the notion of body.

X. Nor does this unresisting nature of matter accord well, with what is said in another place, where the general laws of motion are owned to proceed from the *inactivity* of matter. It is said, " We have  
 " already considered the *inertia*, or passive  
 " nature of body, according to which it  
 " perseveres in its state of motion or rest :  
 " receives motion in proportion to the force  
 " impressed : and resists as much as it is  
 " resisted. Which is the sum of the three  
 " general laws of motion." (c) Now when

(c) Page 148.

it

it is said, For ought we know, such different kinds of matter may exist, as that equal quantities of them may have their *inertia* unequal, it is saying, These three laws, which are the foundation of Sir *Isaac Newton's* philosophy, are to us very doubtful. If A were a solid body of unresisting, or less resisting matter, and in contact with B, an equal body of resisting matter ; A could not communicate to B all the force that were impressed upon it, because it did not resist equally by supposition ; and yet it would communicate all the force impressed upon it, because its solidity could not yield : which is a plain contradiction. Thus *action and re-action* would not be equal ; and yet they would be equal, at one and the same time. The obvious consequence of all this is, as was observed before, That such unresisting matter could not be employed in the operations of nature with other resisting matter, without either resisting as much, as other matter resists, or losing its solidity. In such inconveniencies do men entangle themselves, while they would scepticize unseasonably !

XI. Again,

XI. Again, If equal quantities of solid matter may have their *vis inertiae*, or resistance to a change of their state, unequal ; the quantity of motion could not be reckoned in the same manner, in both these different sorts. In the one, the quantity of motion, or force, is got, by multiplying the matter into the celerity : but if the second sort had only one half, or one third the resistance of the first, an equal resistance or force in it, must be got by twice or thrice that quantity of matter into the same celerity ; or that quantity of matter into twice or thrice the celerity. Or if the quantity of matter and celerity were the same in both, the moment of the one, would be as much less than the moment of the other, as its resistance was less. This would perplex the computation of forces, and the whole theory of the shock of bodies. If equal bodies of these differently resisting matters encountered directly, the force of the one could not stop the force of the other, according to the general rule, though their celerities were equal. It had been worth while to have adverted to these plain consequences,



sequences, which every boy can draw. — Nor could weight discover the true quantity of matter in bodies, except it were supposed that both sorts gravitated equally ; that is, as was said above, resisted a change of state equally ; which is contradictory to the first supposition.

XII. A constant disagreement would ensue in the common affairs of life, on this supposition. The balance could be of no use in trade, nor weight a sure measure of what was bought and sold : nor could any method else be invented, I think, to supply its place. It is indeed said, “ It is only  
 “ when we compare *those* of the same kind,  
 “ that we can affirm their *inertia* to be  
 “ proportional to their quantity of matter.” This supposes that we know when we compare bodies of the same, or different kinds : but when it is said, “ for ought  
 “ we know,” it seems to contradict this.— In short, this is endeavouring to raise a doubt, which, if there were any ground for it, would breed inextricable confusion both in philosophy, and in the mutual dealings among men. Weight is not only the indisputable

disputable measure of things that are most valuable in traffic ; but in the nicest experiments in philosophy, the quantity of matter in different sorts of bodies, is reckoned from their different specific gravities. Thus gold is found to contain 19 times more matter, than an equal bulk of water ; and equal bulks of gold and mercury are as 19 and 14. And it seems strange to surmise, or assert the possibility of such different sorts of matter, as would perplex the daily affairs in life, and disturb Sir *Isaac Newton's* whole philosophy : nor is it easy to see, how such a suggestion could fall in with the account of his philosophical discoveries.

A serious reader will pardon me for discussing this particular minutely, as it is the foundation of all that is said, in the first part of the Enquiry into the nature of the human soul, and of a good part of what is contained in *Mathe.* From this firmly established, the rest will proceed easily.

## S E C T. II.

*The consequences of the inactivity of matter.*

*Those who assert, That whatever was formerly supposed done by matter, is performed by the immediate power of the Deity, are censured for putting a stop to our enquiries into the most sublime part of philosophy. Sir Isaac Newton's conjecture concerning the cause of gravity injudiciously brought in, as if he had been positive about that cause. Gravity shewn from many plain reasons to be the immediate effect of Divine Power.*

**F**ROM the *inactivity* of matter it was inferred, that such a substance as resisted all change of its present state, could have no sort of active power; that *gravity, elasticity, repulse*, and the various kinds of attraction, such as were called *powers* of matter, do not really belong to it; that they are not mechanical, or the effect of matter and motion; and therefore that they were the immediate effects of immaterial power; or that the Deity acted incessantly on all the parts of

C

this

this dead substance, to impress motion upon it, to repair the motion lost in the action of bodies upon bodies, and constantly to produce the wonderful works which we behold in the Universe. This is censured as injurious to philosophy, and impairing the beauty of nature. I shall give the place at large, because the censure extends to others. It is said,

II. " Some from their fondness to explain all things by mechanism, have been led to exclude every thing but matter and motion out of the universe. Others, from a contrary disposition, admit nothing but perception, and things which perceive ; and some have pursued this way of reasoning, till they have admitted nothing but their own perceptions. Others, while they overlook the intermediate links in the *chain of causes*, and hastily resolve every principle into the immediate influence of the *First cause*, impair the beauty of nature, put an end to our enquiries into *the most sublime part of philosophy*, and hurt those very interests which they would promote. In framing

“ framing those systems, he who has prosecuted each of them farthest, has done this valuable service, that while he vainly imagined he improved, or compleated it, he really opened up the *fallacy*, and reduced it to an absurdity.” (d)

III. This charge, so far as it concerns the First Part of the Enquiry, is renewed afterward. All I shall say to it at present is, That I do not see how denying the *powers* of a dead substance, is impairing the beauty of nature. The beauty of nature remains the same, to whatever cause men may ascribe it; they may endeavour to vilify the art, by assigning a cause of it impotent and blind; but that does not change the nature of things. A *chain of causes*, is a notion crept into philosophy, which men think they may suppose without proof. It cannot be a chain of material causes: a material cause, is a cause without *power*, as

(d) Page 95. Those who have considered the three different systems here mentioned, can best judge whether the First Part of the Enquiry into the nature of the human soul, deserved to have been ranked in such company.

well as without *knowledge*. And all that we can find for it is, one material cause above another, till the first is out of sight. Such causes were first supposed by *Democritus*. *Epicurus* and *Lucretius* admitted no other *first cause* than matter and motion. *Des Cartes* disguised the supposition a little, and gave it a new material dress. It has been taken up by *Spinoza* and *Leibnitz* since his time, and in part rejected. It is now on the decaying hand. The intermediate links of the chain disappear, one after another, as men begin to examine them more narrowly. — In the moral world *second causes* are real, and necessary; because rational beings must be free agents; and it would be absurd to suppose the Deity to do all that is done among men. The expression of *second causes* is from thence become familiar, and does not offend the ear: but it is as absurd to suppose dead matter a second cause in the material world, as to suppose free agents *mechanical instruments* in the moral world. And the one of these suppositions leads to the other, as appears in the writings of the three last authors just named. Material causes lead to fatal necessity.

IV. As

IV. As to impairing the interests I would promote, I am not sensible that I have impaired the interests either of philosophy or religion, both which I had in view, and which must always go together.—The great end of enquiring into the works of nature, and the constitution of the universe, is to discover the *First Cause*, the contriver and performer of these works; to see his Power and Wisdom, without a veil of matter to intercept the view. Any other justifiable *end* cannot, I think, be assigned. While philosophers are employed in searching out *subtile matters*, which are invented, and disappear successively; other men are not forbidden to pursue this discovery. The art and performance cannot be worse, if it can be shewn to be the immediate work of the Creator. This cannot hurt the interests either of philosophy or truth. Is not art worth enquiring into, unless it be the immediate work of a lifeless and powerless substance? Why then is this said to put an end to our enquiries into the *most sublime part of philosophy*? That matter should copy so unerringly and constantly, such va-

rious and wonderful art, in all places at once, really discourages our enquiries into the most sublime part of philosophy, if ~~this~~ be it. Men of learning and genius, might rather indulge themselves in rational pleasure, in discovering and admiring the beauties of *Divine Art*, than amuse the world with the notion of *subtile matters*, that can perform such wonders. The art of a blind cause begets a struggle in the mind.

That those who prosecute this system, have laid open the *fallacy* of it, and reduced it to an absurdity, is a thing which remains yet to be shewn.

V. All that is named of the *links* of this *chain of second causes*, is the *subtile æthereal medium*, supposed by Sir *Isaac Newton* to exist. Many other kinds of matter, as has been said just now, were formerly supposed to produce the various surprising effects we behold. *Epicurus* formed his *atoms* eternal, necessary, weighty and infrangible. *Aristotle's* followers gave every particle an occult quality, or peculiar virtue. *Des Cartes* divided the whole mass into three sorts of active matter. These have been all



in vogue, and have afterwards fallen into disrepute : but they who see the system of nature truly demonstrated by the great man just now mentioned, have substituted this *new matter* in their place, which it seems they resolve to subdivide into many sorts, that have different powers. Some pages after the place last cited, several *powers* are named, as the *power* by which the particles of fluids form themselves into drops ; the *power* by which the parts of hard bodies cohere together ; the *power* by which the rays of light, on entering into water, glass, or any other medium that has a refractive *power*, are constantly bent towards the perpendicular. These and many other *powers* in nature, are owned to be analogous to the *power* of gravity. The *effluvia* and *vortices*, imagined by former philosophers, to account for these *powers* mechanically, are allowed to be unsatisfactory. (e) Then it is added,

## VI. " In

(e) I shall give the place referred to, here at length. It is said, page 108.

" Because the *power* of gravity is so well known to us, when we enquire into other *powers*, we endeavour

VI. “ In all the cases when bodies  
 “ seem to act on each other at a distance,  
 “ and

“ your to compare them with that of gravity, and to  
 “ determine their proportion. We find a *great va-*  
 “ *riety of powers* analogous to it in nature ; such as  
 “ *that* by which the particles of fluids form themselves  
 “ into drops ; *that* by which the parts of hard bodies  
 “ cohere together ; *that* by which the rays of light, in  
 “ entering into water or glass, or into any medium of  
 “ a greater refractive *power*, are constantly bent to-  
 “ wards the perpendicular, and when they are inci-  
 “ dent upon the farther surface of the glass with a suf-  
 “ ficient obliquity, are all turned back into the glass,  
 “ though there be no sensible medium behind the glass  
 “ to reflect it ; in the same manner as a heavy body  
 “ projected obliquely upwards is bent into a curve, and  
 “ brought back to the earth again by its gravity.  
 “ *These, and many other powers* in nature, have an ana-  
 “ logy to gravity, but extend to less distances, and ob-  
 “ serve laws somewhat different. It has been found  
 “ very difficult to account for them mechanically.  
 “ For this purpose, some have imagined certain *effluvia*  
 “ to proceed from bodies, or *atmospheres* environing  
 “ them ; others have invented *vortices* ; but all their  
 “ attempts have hitherto proved unsatisfactory. That  
 “ such *powers* take place in nature, and contribute to  
 “ produce its chief phænomena, is most evident, but  
 “ their causes are very obscure, and hardly accessible  
 “ by us.”

If

“ and tend towards one another, without  
 “ any apparent cause impelling them, this  
 “ force has been commonly called *attrac-*  
 “ *tion*; and this term is frequently used by  
 “ Sir *Isaac Newton*. But he gives repeat-  
 “ ed cautions, that he pretends not, by the  
 “ use

If it be very difficult to account for these things mechanically, and if their causes are to us hardly accessible; one would think that the author should have been cautious not to contend that they are mechanical, without knowing how they are mechanical. This is an obvious consequence. And it was still less cautious, to bring in the authority of the greatest philosopher of any age, for their being mechanical. — The word *power* here is ascribed to every appearance in nature, and supposed to be exerted by the *particles* of fluids, of hard bodies, by the *rays of light*. When we stop a little in reading, and consider this, What is it but saying, The power which matter hath *to move itself* to, or from other matter, according to the various phenomena which are to be effected? This is plainly supposing the great question in dispute, instead of proving it. And it is very inconsistent with what the author says elsewhere, “ Body not only never changes  
 “ its state of itself, in consequence of its passive nature,  
 “ or *inertia*; but it also resists when any such change  
 “ is produced: when at rest, it is not put in motion  
 “ without difficulty; and when in motion, it requires  
 “ a certain force to stop it.” page 99. — It was  
 observed

“ use of this term, to define the nature of  
 “ the *power*, or the manner in which it  
 “ acts. Nor does he ever affirm, or in-  
 “ sinuate, that a body can act upon an-  
 “ other, at a distance, but by the *inter-*  
 “ *vention of other bodies*.—He has plainly  
 “ signified, that he thought that *these*  
 “ *powers* arose from the impulses of a *sub-*  
 “ *tile æthereal medium*, that is diffused over  
 “ the universe, and *penetrates the pores of*  
 “ *grosser*

observed in the First Part of the Enquiry, That *power*  
 is the most precious thing in nature. *Power* and *Know-*  
*ledge* are the two perfections to which the creation of  
 all things, and their constant preservation, are owing:  
 but at this rate it is easy to make as many *powers* as  
 one has a mind to. If matter or body, necessarily re-  
 sists all change of its present state, and yet performs  
 whatever we see done in nature; one of two things  
 must be said: Either that the same quantity of motion  
 still remains in the universe, as *Des Cartes* affirmed,  
 which this author justly rejects, and disproves: or  
 that matter moves itself, which flatly contradicts its re-  
 sistance to a change of its state. This is a hard dilemma.

The word *power* is frequently made use of in philo-  
 sophy, as when we speak of the *powers* of algebraic  
 quantities, or of the *powers* in mechanics. In these last,  
 by the skilful application of gravity, elasticity, or of a  
 living force, with a greater celerity, we raise a weight  
 with a slower motion. But it is an unpardonable mistake  
 in

“ grosser bodies. It appears from his let-  
 “ ters to Mr. *Boyle*, that this was his opi-  
 “ nion early; and if he did not publish it  
 “ sooner, it proceeded from hence only,  
 “ that he found he was not able, from ex-  
 “ periment and observation, to give a sa-  
 “ tisfactory

in this case to suppose the *power* itself mechanical. If  
*power* were mechanical, not only *men*, but even the  
*Deity* could do nothing, except mechanically; or he  
 and all living beings would be necessary agents, if ne-  
 cessary agent were not a contradiction. This is just  
*Spinoza's* scheme of necessity. There is nothing me-  
 chanical in a watch, or any engine, except giving the  
 parts a due figure, and joining them together, so that  
 they may communicate the force impressed by the  
 power, to the last part designed to be moved. And  
 the case is the same in the body of man, or of  
 any other living creature. This I beg may be  
 taken notice of by any who shall read these papers. For  
 if this easy observation had been attended to, both phi-  
 losophy and religion itself, would have worn another  
 dress, than what they have at present. But by a loose  
 and indetermin'd use of the word *power*, we come at  
 length to imagine that these *powers* here named belong  
 to matter, which is altogether wrong. And since  
 matter has absolutely *no power*, we cannot be rash in  
 ascribing them to an *immaterial cause*; and that is, to  
 the Deity, whose power is infinite, and his knowledge  
 to direct the exercise of it, boundless. What are called  
 powers

“ tisfatory account of this *medium* ; and  
 “ the manner of its operation, in produ-  
 “ cing the *chief phenomena* of nature.” (f)

VII. Here I think it is injurious to this great man’s reputation, to bring in his authority for a thing, which he owns to be only conjectural ; or rather, which he asks only by way of *Quære*. Why should this be again brought into the question, as if he had been positive ; if any good reason can be brought against it ? or, unless the *experiments* and *observations* had been since discovered ? This is an ill office done to his memory. How much more is he to be praised for his ingenuity, than *Des Cartes*,

*powers* in the place cited, are only *effects* produced by power, or the different ways of exerting one and the same *power*, according to the variety of things to be performed. To suppose *these powers* belonging to matter, is indeed making *occult qualities* of them, or disguising that old ridiculous notion under a new name.——

They are here said to be analogous to gravity, that a certain *subtile matter* may pass for the efficient cause of them all : their analogy to gravity consists in this, That they are the immediate effects of the same immaterial power.

(f) Page 109—III,

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who

who boldly asserted as many kinds of *active matter*, as fitted his hypothesis, without either observation or experiment? If this *medium* is found to be without ground, the mentioning it so often, has a tendency, with the unthinking, to lessen his authority in other points. May we not allow this excellent person to have been so far wrong as not to have guessed right, and that in one particular only? How few can compare with him in this particular! It is the greatest praise perhaps that ever was given to any philosopher. But to bring it always on the carpet, makes it more to be taken notice of, by ignorant people, than the most noble of his discoveries. And as it is every man's right to enquire into these matters, for his own satisfaction, and to free his mind from the uneasiness of supposing, that matter is the *immediate efficient* of all the wonders we see around us; authority will not hinder men from examining appearances, tho' they should be lookt upon as *ignorant*, or *such* as ought not to meddle with these subjects. Contrary principles seem to me, and perhaps to others, very desirable. If the notes to the First Part of the Enquiry had

had been attended to, or duly considered ; I had been freed from this ungrateful task, to which arguments are not wanting. Even in a place cited above (*Señ. I.*) such reasons are brought against this conjecture, as plainly shew *gravity* itself, to which the other *powers* named, are said to be analogous, not to be mechanical, nor owing to any material impulse.

VIII. It is there asserted, from many *experiments* and *observations*, that this power *penetrates* the substance of bodies, even to their very centers. How can a *subtile medium*, let it be as subtile as we please to imagine it, penetrate the solid substance of bodies ? It is still matter, and solid, resisting matter ; otherwise it could impress no force. And that one part of solid substance should penetrate another part of it, is inconceivable, and destroys the very conception of body. Two parts could not occupy the same space, except the solidity of one of them gave way. But it is very conceivable, and demonstrable too, from the *attraction* of cohesion (as it is called, of which more by and by) that immaterial power,



power, acts on, and pervades, all the parts of matter universally. And since this is indisputable, if the reader will bear it in mind, he will easily see, not only that gravity is not the effect of matter upon matter, but that the power of the Deity prevents, and excludes all the active powers that could be pretended to be in matter; as it is needless to deny his immediate power in one case, when we see it is beforehand, and preventing us, in another. Now since gravity is thus "*found* to affect" "all the matter in bodies," and "to affect" "their *internal parts*, with the same force" "as their *external*," it is to no purpose to say only, "that it penetrates the pores of" "grosser bodies;" or to allege that all bodies, the very densest, are extremely rare, or contain a small quantity of matter, in proportion to their bulk. Still they must have *internal parts*, that are surrounded on all sides by *external parts*: and denser bodies must have more internal parts, accessible to no matter from without; unless it be again denied, that bodies have any internal parts. We cannot conceive that there should be nothing in bodies but *pores*, or  
that

that solid substance should be all surfaces. That is repugnant. A surface has only *breadth* and *length*, without a third dimension, that is, without any solidity. — Gravity is there said “to be obstructed in its action, by no intervening body, or obstacle.” Surely this is a property that excludes material impulse. Matter is always obstructed by intervening matter. If the lightest body, as *cork*, were inclosed in gold, to any thickness, it would gravitate as much there, as if exposed in the open air. Could impelling matter find no resistance from gold, and yet impinge on a rarer substance? It was from such an experiment as this, that *Archimedes* discovered the fraud committed in making King *Hiero*’s golden crown. And it is because of the obstruction from intervening matter, that *effluvia* cannot account for attractions analogous to gravity. — In a word, no arguments can be more conclusive against this *medium*, than those this author himself has furnished in the place before-cited. But there he was arguing for the universality of gravity, and here for its being the effect of material impulse.

IX. And

IX. And as it is to no purpose to pretend that the densest bodies are extremely rare, so it is to as little purpose to insist on the great subtilty and rareness of this *medium*. As has been said, it must be matter, and solid, resisting matter, to produce any effect, or impress the strong force in the fall of a stone, or tumbling down of a rock. An ordinary man could hardly resist the force it impressed on a cubical foot of lead, or raise that weight contrary to its impulse : and if we consider how easily such a man could resist the force impressed on an equal volume of air, or even of water ; we shall rather find reason to conclude this *medium* (if there were such a thing) to be extremely dense. It is elsewhere observed concerning the resistance arising from a subtile medium, “ as for a more subtile medium than the “ air, no experiment, nor observation, shew “ that there is any here, or in the celestial “ spaces, from which any sensible resistance “ can arise.” (g) And yet if an *athereal medium* were the cause of gravity, it should be very dense in the celestial spaces, to im-

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pel

pel the heaviest bodies in proportion to their density, and in proportion also to the quantity of matter in the bodies towards which they gravitate.—For let it be considered that, since the gravity of bodies at the surfaces of *Jupiter*, *Saturn*, the Sun and our Earth, are as the numbers 943, 529, 10000, and 435, gold would be near one-fifth heavier at *Saturn* than with us, more than doubly heavier at *Jupiter*, and twenty-three times heavier at the Sun. What shall we do with this? Gold here is 19 times heavier than water, but the same identical substance at the Sun would be 437 times heavier than water.—We are not therefore to estimate the density of this *medium*, as it impelled light bodies, but as it impelled the very heaviest, gold, mercury, and other metals : and as it impelled them likewise to the greatest bodies in nature. Either of these consequences are irreconcilable to the nature of such a *medium*. It cannot be very rare, as it impels cork ; and very dense in the same place, as it impels gold. And then, as I argued formerly, it is an inexplicable circumstance, with respect to an impelling *medium*, that it should urge

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bodies,

bodies, not only in proportion to their own quantity of matter ; but in proportion also to the quantity of matter in other bodies at a great distance. — Now, if there were such a *medium*, since its density was to be computed, not according to the rarer bodies, but according to the most compact and dense bodies which it impelled ; it would be much more dense than either air or water, and not only impede the motions of the planets, as it is said to be diffused over the universe ; but it would resist all the motions on our earth, that were not directly downward, or perpendicular to the horizon. As its direction is constantly towards the center of the earth, if we moved horizontally, or at right angles to its direction, we should have it to struggle with, as if we waded through an ocean of mercury, or some fluid still more dense.

X. This is a very familiar argument ; but the reasoning is so much the more obvious, and lies open to be examined. It may satisfy the plainest people, that such a medium is supposed, without any foundation in nature, and contrary to constant,

and universal experience. This argument could not be shifted, by pretending that it was the quicker impact of this *fluid* on dense bodies, than on rare, that caused their difference of specific gravity : for light and heavy bodies fall with equal velocity, abstracting from the resistance of the air. Its greater force therefore must proceed from its greater quantity of matter in the same volume ; that is, from its greater density. Where the celerity is equal, or the same, the force or moment must be as the quantity of matter.

XI. It is said, very arbitrarily, that this *medium* is denser at the surface of great bodies, than at the surface of those which are less ; because the gravitation is stronger towards great bodies, than towards those that are less, if the distances be equal. But this would disorder the motions of the planets for good and all.—If the distances of two Planets from the Sun, A and B, were as 4 and 1 ; the density of the *medium* at the nearest B, should be 16 times greater than at A, to produce the proper gravitation of the planet at that distance. The velocity  
of

of B would be double that of A. The resistance it would meet with from the *medium*, would be as the square of the velocity multiplied into the density of the *medium*; or as  $4 \times 16 = 64$ . Thus it would meet with 64 times more resistance from such a *medium* than A: and yet its projectile force to penetrate this *medium*, would only be twice greater, or in the ratio of its velocity. Thus the nearer planet would be stopt, or go directly down to the sun. The motions of the planets could not be performed in any such *medium*; they agree only with unresisting space.——But what should cause the greater density of this *medium* near great bodies? Does it gravitate like our air, whose density is increased by the weight of the super-incumbent mass? This would be accounting for *gravity* by *gravity*. The matter that produced gravity in bodies, should be itself without gravity. It would be hard to prove that all matter gravitates, if one sort of matter produced gravity in another sort.——In fine, the density of this *medium* would be (like the weight of bodies, which it causes) inversely as the squares of the distances from remote bodies; and inversely also as the squares of

the distances from other near bodies. That is, it would be very dense, and very rare, in the same place, and at the same time, or have many different degrees of density and rarity, according to its different nearness or remoteness from other bodies : and its impulses would be as opposite and inconsistent among themselves, or it would have many different and contrary motions at once. Let those who imagine the reality of this medium, reconcile these properties of it to truth and nature.——That bodies do gravitate in all these different manners, is very certain, both from reason, and our own constant experience : and it is as certain, that nothing could impress this force upon them, with such variety at one and the same time, and with such regularity at all times, and in all distances, except the adorable and wonderful power of the Deity. All difficulties cease, when we have recourse to the adequate cause,

XII. But I would ask, How this medium could operate, not only at the surfaces, but within the bodies of the planets themselves ? It has not there free spaces to act in, and its impulses would be obstructed :



ed : yet bodies gravitate within the surface of our earth, where they are surrounded with dense matter, as regularly as in the open air.——Nor are these all the difficulties that occur, if we consider the action of this, or any other *medium*, that should produce the different appearances in gravity, and in other attractions analogous to gravity. If a *fluid* impels a body at rest, and gives it a certain degree of celerity, it cannot impel the same body afterwards with the same force ; because the celerity of the body is now to be deduced from the celerity of the *fluid*. And if it gives the body a second impulse, that must be weaker, and a third impulse must be still weaker ; and so on : for the velocity of the *fluid*, with respect to the body, must still become less, as the velocity of the body is accelerated ; till at length they both move with the same celerity, and the *fluid* can impress no more force on the body. But this is not the case in the fall of heavy bodies. The force impressed upon them is still equally strong, how great soever their celerity be ; and in equal times their fall is equally accelerated, and their force equally increased. The

*Dutch* philosophers are very particular in observing this (*b*) ; and our author himself plainly expresses it in the following passage, where all attempts to account for gravity mechanically are rejected as unsatisfactory.

XIII. “ But all we want to consider  
 “ here is, that this *power* extends univer-  
 “ sally to all sorts of sensible bodies, at, or  
 “ near the earth’s surface ; and that it has  
 “ these two remarkable properties : first,  
 “ that it is proportional to the quantity of  
 “ matter in bodies ; secondly, that it acts  
 “ continually, and with the same force up-  
 “ on a body that is already in motion, as  
 “ upon a body that is at rest. This last  
 “ properly appears from hence, that it pro-  
 “ duces equal accelerations in equal times  
 “ in falling bodies. Both these properties  
 “ distinguish it from such causes as are  
 “ *wholly* mechanical ; which either act in  
 “ proportion to the surfaces, or to the bulk  
 “ of bodies, and produce less acceleration  
 “ in a body that is already in motion, in  
 “ the direction in which the cause acts,  
 “ than upon a body at rest, in the same  
 “ time,

(*b*) See *Musschenbreeck’s Beginsels der Natuurkunde.*

“ time. We here observe these things  
 “ concerning gravity, not with a view to  
 “ determine any thing concerning its cause;  
 “ but only to pave the way for what fol-  
 “ lows concerning the universality of this  
 “ principle.” (i) This, I think, is to be on  
 one’s guard indeed, not to determine any  
 thing, when reasons for determining offer na-  
 turally. Gravity must either be mechan-  
 ical, or not mechanical. To argue conclu-  
 sively against the first, both here, and in  
 the former, and in many other places ; and  
 yet not to determine for the last, is caution  
 carried to an excess, whatever the motive  
 may have been. Gravity is allowed to be  
 a sort of *magnetism* ; tho’ if *magnetic efflu-  
 via* are rejected, we cannot be sure but that  
 magnetic attraction is an effect of immate-  
 rial power. Gravity is shewn not to be  
 owing to the pressure of the atmosphere,  
 nor to the subtile matter of *Des Cartes* : but  
 would it be less mechanical, if it were ow-  
 ing to any other subtile matter ? To deny  
 that it can be the effect of the first subtile  
 matter, and to suppose that it may be the  
 effect of the last, as if it would not be  
 equally

equally mechanical in either case, is a strange sort of reasoning. — The two properties mentioned above, distinguish the cause of gravity *from such as are wholly mechanical*. If an effect be not *wholly* mechanical, but partly mechanical, and partly not mechanical ; to what cause is the part that is not mechanical owing ? Must we admit an *immaterial cause* to that part, and divide the effect between the power of the Deity and dead matter ?

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## S E C T. III.

*That a body at rest cannot act upon another, either at a distance, or in contact with it. The approach of bodies to each other in gravitation, improperly expressed by the word attraction. Of the attractions said to be analogous to gravity. Appearances not to be called trifling, because we despise them, or know not the use of them in nature. Of magnetic attraction; of electrical attraction and repulse; of the attraction between the particles of fluids; of the cohesion of the parts of matter; of elasticity.*

**W**HEN it is said, *That a body cannot act upon another at a distance, but by the intervention of other bodies,* it is fit to observe, That a body cannot act upon another, tho' in contact with it, either to attract or to repel it, more than if it were at a distance, and nothing but pure space between them. Only let us remember that matter is an inactive substance, and resists all change of its present state; and the necessary

necessary consequence is, That it cannot act in any case, on other matter, either distant or in contact with it. If a body at rest be in contact with another body, we easily allow that it cannot begin to move towards that side, to push the other body from it ; nor can it begin to move towards the contrary side, in order to draw the other body after it, or that the other body may follow it.—This is mighty plain reasoning : but it is universal, and true of every particle of the whole mass of matter. How then comes it to be supposed, *That a body can act upon another at a distance, by the intervention of other bodies ?* This is a very unphilosophical notion. When a stone begins to move towards the earth, it is not pushed by matter from behind, nor drawn by matter before it. It would meet with less resistance, and move with more celerity, if all were a perfect *vacuum* quite round it. This is plain from the experiments in the exhausted receiver. It begins therefore to move, when there is no *action* or *re-action* between the earth and it, or without any material impulse. And since this reasoning is built upon repeated experi-

experiment, it is plain here that the stone begins to move by *immaterial power*, that same POWER which first impressed motion on matter : and this, I think, must be very satisfactory to all impartial judges.

II. From this it appears, that the word *attraction* is improper to express such a motion, as if one body drew another to it by the means of some material communication, as when a boat is drawn towards the ship by a rope. Nor is *repulse* a more proper term, when the particles of air, after compression, recede from each other by what is called *elasticity*. They were not before in contact ; and although they had been in contact, they could not even in that case have acted upon one another, by what was said just now.—Yet because this *approaching to*, or *receding from* each other, is, as if the bodies *were drawn*, or *were repelled*, or as if there were *action* and *reaction* between them ; these terms may stand for such motions conveniently enough, as they are familiar in this subject ; provided we always remember, that it is only for want of more proper words to express  
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the nature of these motions. And this caution is absolutely necessary, because any other sense of these two words plainly contradicts the *vis inertiae* of bodies, and begets an inconsistency in the mind, and in our reasoning. For wherever we speak of bodies *attracting*, or *repelling* other bodies, whether in contact, or at a distance, we affirm *immaterial power* acting on them, as certainly as we affirm the inactivity of matter, or deny it to have a self-moving power.—These things being premised, we may now consider the other attractions, said to be analogous to gravity.

III. With respect to these we may observe, that attraction of all sorts is mutual ; that is, both bodies are moved, and approach to each other ; or a force is impressed *ab extra* on them both, since they have not a self-moving power, whereby each of them runs over a certain, stated part of the distance between them. This is inexplicable by any subtle matter. Two bits of cork swimming upon water, approach towards each other, and at length meet at their common center of gravity.

What



What should determine the subtile matter to take opposite directions, and to impel these against each other? There must be *a principle of beginning motion* here, and of directing it. Matter has no such power, as has often been said. To say, The cork determines the subtile matter to impel itself, is to find a mutual causation between the parts of matter. The particle A determines the particle B to impel it; and the particle B impels it accordingly. If this were so, we need go no farther for the origin of motion. Nor can any other matter determine the subtile matter to take this turn. Set a larger piece of cork near the other two, and they both approach to it. In this case therefore the cork determines the subtile matter, or no other matter at all determines it. But how could the cork act on the subtile matter, to determine it? Is it by *pushing*, or *drawing*? Both these I have shewn to be impossible, whether the subtile matter be supposed in contact with it, or at a distance. To suppose *a body to act on distant bodies, by the help of intervening matter*, is quite unphilosophical, and against the resistance  
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of all matter to a change of its state. Any child may make this experiment : but it is so much the more easily tried, and the reasoning examined.

IV. We want here then *a principle of beginning motion*. No sort of matter could afford such a principle, and without immaterial power motion could never be begun. —But what, it will be said, shall we interest the immediate power of the Deity in such trifling appearances as these ? There is no *dignus vindice nodus* here. I answer, We must by all means call in the immediate power of the Deity, the Creator of heaven and earth, even here, in this trifling appearance ; since all the matter in the universe cannot account for it. Is not this an *attraction analogous to gravity*, and called *a power in nature* ? But subtile matter has as little power to perform this attraction, as the most lumpish matter we can name, as the rocks on mount *Caucasus*, or the *Alpes*. If the subtile matter cannot account for the principal attraction of gravity, it can as little account for those that are analogous to it. Is not the power of the Deity immediately

ately interested in the cohesion of all the parts of matter, even in the cohesion of the parts of those very bits of cork? If all the philosophers on earth can account for this cohesion otherwise, I shall be silent; but if that be impossible, such questions are from the purpose. There is no intermediate link between this attraction and the power of the Deity, more than between the gravitation of the planets and his power. The power of the Deity is more universal than our prejudices will allow us to think. Wherever there is matter, there it is put forth, of which I shall speak immediately. And that appearance cannot be called trifling, which shews us his immediate power, without a cloud of dead substance to darken the prospect.

V. The reasoning above is applicable to the great bodies in nature, as well as to the small. Two planets gravitate to each other from a vast distance, and if not prevented, would meet at their common center of gravity. What should direct the *æthereal fluid* to impell them thus? They both gravitate towards a third planet. That third planet

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therefore must give the fluid a new direction, or no matter at all directs it. And if we exclude immaterial power, it must direct itself or have a self-moving power. This would in effect put an end to our enquiries into the most sublime part of philosophy. The two planets cannot attract each other at a distance. That would be *to act where they are not*, which is really a *charm*. The author says, “ possibly some unskilful men “ may have fancied, that bodies might “ attract each other by some *charm*, or “ *known virtue*, without being impelled “ or acted upon by other bodies, or by “ any other *powers* of whatever kind.” (g) If the power of the Deity be a *charm*, it is that charm by which the universe, and the fullness thereof, were created, and are still preserved : and if it be an *unknown virtue*, it is the greater shame for philosophers.—— This reasoning likewise seems to go far in disproving the impulse of a subtile matter in any sort of attraction : for it is as applicable to the *magnet* and *iron*, swimming on pieces of cork, as to the cork itself. The matter that impelled the *iron* to the *magnet*, could

(g) Page 10.

not contrarily impell the *magnet* to the *iron* : nor could the *magnet* and *iron* act on this matter to impell themselves, without supposing them to begin motion where there was none, by *pushing* the matter from, or drawing it to themselves ; which, besides contradicting the resistance of matter to a change of its state, supposes attraction in order to account for attraction, or *repulse* previous to *repelling*.——I again repeat it, wherever there is motion, where before there was none, there must be a *principle* of *beginning the motion*, different from matter, which we are demonstratively certain has no self-motive power. If this plain truth had been attended to, it would save philosophers a world of disputing, and foolish hypotheses about *subtile matters*. And I wish some great man had recommended it, whose authority would have made it current (b).

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VI. If

(b) Immaterial power in *attraction* and *repulses* between the parts of matter, that is without any intervening matter, seems to produce all those surprising effects, which were supposed to be caused by certain *powers*, or *qualities*, inherent in the matter itself. It is no way probable, that there are any *magnetic effluvia*, or subtile matter, issuing out of the *iron* and *load-stone*. We cannot

not

VI. If we consider another sort of attraction said to be analogous to gravity, namely

not conceive that they should begin to emit these, by only being put near one another, more than the two bits of cork mentioned above : and by the observation just now made, there must be a *principle* of beginning motion, different from matter, such as are *attraction* and *repulse*. In order to make our senses judges of this, let us consider that a load-stone draws to it a weighty key, and keeps it suspended. The *magnetic attraction* therefore is stronger than the weight or gravity of the key. And if I have argued right about the *density* of the supposed *æthereal medium* that should impell the key downward, the impulse of this *medium*, if real, should be felt as much at least on the same space, as the weight of the key which it produces, is felt. If a piece of *iron* weighs a pound, or half a pound, when supported and at rest, an equal force should be felt on the hand, pressing perpendicularly downward, when the key, or *iron*, is not there : for by supposition the *iron* would have no weight, or not gravitate at all, were it not for the impulse of the medium.—Now the *magnetic effluvia*, if there were such, being stronger, and therefore *denser*, should be more felt, and really attract any body as heavy as *iron* ; and lighter bodies more easily. All this follows from the nature of a *dense medium*, and reduces the point, I think, to an easy experiment, where our senses are judges. And it seems to confirm this reasoning, that *magnetic attraction* is not obstructed,  
by

namely that whereby the particles of fluids form themselves into drops, it will be as difficult

by intervening bodies, tho' very dense, more than gravity. Which is altogether inconceivable, if a dense medium impressed these strong forces. It has been observed by Sir *Isaac Newton*, from the *fits* of easy refraction, and easy reflection of the rays of light, that *attraction* is easily turned into *repulse*: and these two immaterial powers can only account for the strange appearances that are observed between the *iron* and *load-stone*, and between load-stones among themselves.

That there are *effluvia* in other cases is certain: all *scents* and *odours* are proofs of it. The vapours raised from water are but one kind of *effluvia*; and the exhalations raised from all bodies, without exception, are *effluvia* of different sorts. But it is to be observed, that they are all thrown off at first by *repulse*, which is an *immaterial power*. And at a small distance they begin to rise in the air, according to their specific gravities, which is *the same immaterial power* differently put forth, and for weighty purposes. When accumulated at a just height in the *atmosphere*, by their mutual *attractions* and *repulses* (which no subtile matter could account for) rain is engendered, the air is moved for health, the earth is watered and made fruitful, and animals, by the odours raised from vegetables, are taught to chuse their food. This is the indulgent providence of the Creator, and not below his immediate care. It would be bad for *man* and *beast*, if a subtile

ficult to reconcile this various effect to the action of any *subtile medium*. Let us observe

medium were left to *produce the chief phenomena in nature*.

Electrical effluvia are of another nature, if at all to be called by that name. I shall beg leave to speak my thoughts of the various appearances electrical bodies exhibit, without being positive in any thing, except that the *attractions* and *repulses* in these are the immediate effects of immaterial power, exerted according to laws we do not understand, and for purposes we cannot penetrate in this state: tho' I firmly believe they are the admiration of higher Beings, and answer greater ends. And this exception is justified by what I have said above.—The particles of fire and light, which are the same, are sometimes strongly attractive, and sometimes as strongly repellent, as was observed just now from Sir *Isaac Newton*. Their repulsive force appears, in that heat increases the dimensions of all bodies, and is the chief mean of throwing off vapours and exhalations. Fluids are quite dissipated by an intense, or continued heat. Their attractive force is plain from many instances in these electrical experiments. The particles of fire and light are excited by *friction* in all these experiments. *Friction* alone often produces fire and burning, as common experience sheweth on many occasions. And there is fire in all kinds of matter, even in cold water, as any one who has seen these experiments, must have beheld with admiration. It is needless to mention the childish diversion of going into a dark place,  
and



serve the attraction between the parts of quicksilver : if it is scattered on a plane, it contracts

and striking fire from two white transparent pebbles, from a cane with a piece of a tobacco-pipe, or from fine loaf-sugar. Oceans of fire and light are continually shed from the sun, and are imbibed by the sea, by the earth, and by all vegetables ; the food of all animals, and whatever we eat or drink, is saturated with this element. It is the chief agent (if I may so call it) in all vegetation. The particles of fire thus excited by friction, rouse the like particles in near bodies, tho' without contact, by attraction. This is visible to the eye. When we put our finger near the tube, in which this matter is excited, or near any person on whom it is so excited (who is then said to be *electrified*) we see a spark of fire appear between the finger and the tube, or any part of the person's body so electrified. It is thus that brandy is set a flaming, and a spark of fire is raised from cold water itself. There is no actual contact, and the fire is raised by *attraction* between the particles. The particles thus roused in the finger by attraction, and suddenly dilating themselves on all sides, raise a smart, or pain in the flesh, exactly the same as is felt by the burning of a spark ; and if the action be strong, a pretty violent shock is felt at the same time, in a distant part of the arm. When the electrified metal, or canon (as they call it) is large, in which these particles are thus excited, the shock, so communicated, is dreadful, as if all the bones of the body were broken at once. Professor *Musschenbroek* at *Leyden*, was the

contracts itself into many small globules,  
instead of spreading into a level surface,  
where

first that felt this shock, a few years ago, and was glad he had escaped with his life. Some stout men of the academies in *France*, and in *Germany*, were bold enough to run the same risque; but no consideration can make those, who have tried this experiment once, venture on it a second time. And I have heard of a proposal to put criminals to death by this experiment. — It is thus, I conceive, that lightening produces such terrible effects, not by the fire in the air, but by the fire in the bodies themselves, thus roused into action, and that without actual contact; tho' we say, *tactus fulmine*. The effects of lightening are extremely surprising: but if we consider, that, in the collision of flint and steel, the particles of the flint are suddenly vitrified by the fire struck out; it is very conceivable that metals may be instantly melted, by the force of the same element, set on action in the same manner as in electrical experiments. And they likewise shew that bones may be calcined, and animals extinguished, without any visible external hurt. One person may be struck dead, while another hard by, is no way affected. Whatever body first attracts the fire, the force is there all spent. Hence turrets, steeples, and tall trees, are most apt to catch the attraction; whence lightning seems to point chiefly to these prominent objects. It is thus the finger held near an electrified body, has the particles of internal fire suddenly set on motion. — Yet this element thus lodged in all terrestrial bodies,  
which

where this particular attraction overcomes  
the universal attraction of gravity. Does  
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which is so violent in these cases, is of universal use to promote vegetation in all vegetables, and strength and health in the animal body. We see all things revive with the returning heat, and animals seemingly dead get new life. These particles of fire in our bodies, seem really what is said to be the *animal spirits*. How soon does a strong spirit tasted, or but held to the nose, recover from fainting, and invigorate all the senses! This is by *attraction* along the olfactory nerves; for these particles have not yet been mixed with the blood. To seek for *animal spirits* in a fluid form, in the nerves, has cost much fruitless trouble.——But to have done, it is probable in these experiments, that an *electrical atmosphere* (as I think it may be called) of this attractive matter, is suddenly excited round the electrified body, and extends itself as far as the body reaches, sometimes to a great distance. It has been found to run along a chain, carried from house to house, and height to height, for more than 5000 feet, and that in an instant; and upwards of 800 men, by joining hands, were all electrified at once, by the touch of one man, on whom the matter was thus raised. Which shews the exceeding swiftness of communication, by this attraction. This *atmosphere* spreads in breadth to 8, and sometimes to 10 inches; as is plain from the experiments themselves, if this were the place to insist on these things. This perhaps might be called the *atmosphere of electrical attraction* properly enough; for  
if

the same *common medium* perform two opposite effects, or must another *medium* be invented on this occasion? It was formerly observed that two contrary forces, or ten-

if you put your finger to the verge of this *atmosphere*, the like particles in your hand or arm, are instantly roused by attraction and exploded (if we may call it *explosion*;) and the other person feels a sudden puncture in the part opposite; for the action is mutual. It is somewhat diverting to see this electrical atmosphere raised upon a dog. He sharls at any thing that points towards him, as dreading the smart, even at a bit of flesh held out upon a fork. The appearances likewise from the *electrical barometer*, as the *German* philosophers call it, are very surprising. A stream of light rises sometimes 50 inches above the mercury, and seems to be within the very substance of the tube. The *resinous electricity* often repels, what the *vitreous electricity* attracts; and contrarily. And the same sort of electricity attracts in one case, and repels in another: it raises a spark of fire from cold water, and drives away gunpowder, scattering it up and down the paper. Which shews attraction and repulse exerted by turns, according to the difference of bodies.

It is thus, I think, that these immaterial powers of *attraction* and *repulse* produce all those surprising effects which we behold, without feigning such powers inherent in matter itself; which is contradictory. A constant resistance to any change of state, and active power to change that state, are not compatible to the same subject.

dencies,

dencies, could not be planted in one and the same subject ; and it will be as difficult to conceive how two different and contrary *mediums* should act upon the same individual matter at once ; or what should give one *medium* (if there be but one) such a various and vertiginous motion. If two of these globules happen to touch, they are immediately drawn into one larger globule. What could determine the subtile matter to impell these particles to each other, however irregularly they fall, or are scattered up and down ? If a subtile matter were employed in this attraction, a *determining principle*, not material, would certainly be wanting. For by what has been said before, the particles of the quicksilver could not determine the subtile matter to impell themselves, without a mutual causation between the parts of matter ; that is, of a dead substance. Two particles without power, cannot beget power between them.—The same effect is remarkable in the drops of dew on the tops of grass. You see millions of small watery spherules, betwixt you and the sun in a morning. If this were to be ascribed to a subtile *medium*, either the  
same,

same, or analogous to that which is supposed to cause gravity in bodies ; what inconceivably little, and infinitely various *vortices* would be necessary to effect it ! Would not what is said against *Des Cartes's* subtile matter, be applicable to this subtile matter ?  
 “ To remove the difficulty a step farther,  
 “ or to involve the question in obscurity,  
 “ *new vortices* are introduced in every infinitely small particle of matter. From  
 “ these, if there be occasion, they will descend into another order, infinitely less ;  
 “ and so on (i).” How much better do we all see the faults in other mens arguments, than in our own.

VII. The attraction of cohesion, or *power* of *cohesion*, as it is called, is named among other *powers* analogous to gravity. This appearance challenges our highest admiration. By it the parts of matter adhere to each other, with wonderful force, and form solid bodies. The force of this action descends infinitely low ; for every part is made up of other parts, so that the very solidity of matter seems to be owing to it.

(i) Page 87.

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The least part affords two surfaces, that might be separated by any force did not immaterial power prevent it. I am not able to stretch a slender wire till I break it; and this resistance proceeds from the strength of cohesion between the surfaces of its parts. Wherever two surfaces can be made, perpendicular to its length, up or down, the whole strength of cohesion is there; that is, the whole resistance is made by these two surfaces, not the 50th part of an inch in diameter.—It is remarkable here, that each of the two surfaces makes its resistance, and the one is opposite to the other: the upper surface resists a force acting downward, and the under surface resists an equal force acting upward; as when two men draw in contrary directions. And these opposite and equal resistances are made between every two possible surfaces, through the whole length of the wire. To pursue this minuteness of opposite resistances distresses the imagination. Another sort of matter pushing the parts to each other, cannot be pretended here; for the parts are in contact. Nor can the little particles themselves exert this force, and make such a great resistance: for I can

overcome their resistance in any other direction, almost without feeling it.—What evasion shall we contrive here then? Neither other matter, nor the particles themselves, could produce this effect. The power exerted is indefinient; as indefinient as that of gravity.—Surely this is a particular where truth stares us in the face. Where we must see the power of the Almighty Creator, whether we will or not, constantly put forth on all the parts of matter. This demonstrates his immediate action every where, in spite of our chicaning philosophy. We can see nothing, touch nothing, move nothing round us, but this conviction must occur. There is no need of intermediate links, and a chain of controverted causes, to discover the Author of our being. Nothing but his immediate power could exert this amazing force in these minute particles. Material impact (if that was possible) in all contrary directions, would mutually destroy itself, and rather dissolve, than cement the parts of matter so strongly together.—This universal phænomenon therefore ought to silence the advocates for material causes, in all cases. For  
wherever



wherever they can *invent* a subtile matter to produce the effect, the immediate action of the Deity is beforehand with them (as I said above) and prevents their hypotheses in those very instances, which they would account for without his power. This is as foolish (if I may use such a comparison) as if we should deny any person to be within a house, at the very time that the people from within are speaking to us.——All these reasons were insisted on before. And to take no notice of them, farther than calling this universal phenomenon *a power in nature, whereby the parts of hard bodies cohere together*, is a new way of establishing philosophical discoveries; this properly is not in hard bodies onely, but in soft bodies, as cork and sponge; in tough and pliable bodies, as the flesh and sinews of all animals, in the twigs, roots and branches of trees, the leaves and parts of all plants. Every sort of body has its degree of cohesion. And are not the original particles of matter supposed *perfectly hard*, and unyielding to any natural force; and consequences deduced, if they should wear, or grow old? As if a substance could wear, that is supported by Almighty power!

power ! cohesion therefore belongs to matter, as it is a solid substance, extended into length, breadth, and thickness.

VIII. Nor is the impression of immaterial power less astonishing and wonderful in gravitation. It is rightly said, “ every particle therefore, of the earth gravitates towards every other particle of it : and for the same reason, every particle of matter in the solar system gravitates towards every other particle in it.” (k) This is a just consequence of bodies gravitating to each other, in proportion to their quantity of matter ; for every particle must attract, and be attracted by every other particle. But O ! how incomprehensible is this various action ! and how contradictory if we suppose it to be owing to the impulse of other matter ! Let a man endeavour to imagine one particle only impelled millions of contrary ways at once, by other particles ; and he will see the impossibility of the effect. Then let him endeavour to conceive that every particle in the whole solar system is thus impelled by surrounding matter, to

(k) Page 277.

every

every other particle in it; and the contradiction becomes monstrous. The ungravitating, or impelling matter, would thus be infinitely more in quantity, than the gravitating matter, that were impelled. Or how could millions of particles find scope to act on one particle, to impell it all possible ways at once? or could this produce gravitation at all, the contrary forces resisting each other? A thought should be made consistent in the mind, before it can appear consistent to others. No man had ever a notion of the possibility of this.

IX. We have here then an effect worthy of Omnipotence, and to be performed only by the immediate operation of the Deity. And from this we may see, with inexpressible satisfaction, the Power of the Creator constantly exerted throughout all nature. The weight of our own bodies determines that, which men of subtilty and learning have been disputing about for ages. This is the true fruit of our enquiries into the works of nature; *the most sublime part of Philosophy*, and gives that pleasure, which a rational being would not exchange for any

other that philosophy affords. And those who require experiments for a proof of every thing, have them here without any apparatus. They are desired to consider the constant facts referred to, in these attractions that are said to be analogous to gravity, which for certainty and universality far excell all the experiments that ever were made by art. They are the experiments of nature, which prevent our industry, and are easily understood. But it is our misfortune to neglect what lies before our eyes, that we may search for it in a dark and learned manner. It would be hard if the Deity concealed himself from the common sense of mankind, that men of leisure might amuse the world with wrangling and contest. Which if they have not done, by a succession of *subtile matters*, from the earliest times, I am greatly to be blamed. But it requires only plain sense, and a love of truth, to see through the imposition.—The whole analogy here (as was said before) consists in this, that these attractions, as well as gravity, are the immediate effects of immaterial power, and not of any subtile matter.

X. I beg

X. I beg leave only to add a word concerning *elasticity*, which remains to be spoke of; and I think we shall be taught to reject even *this subtile matter*, by the arguments that are made use of against *Des Cartes's* subtile matter. *Des Cartes*, and after him *Leibnitz*, asserted, that *the quantity of motion in the universe still remained the same*; a ridiculous fancy, which is contradicted by what we daily see and feel. In the *fall of a rock*, or *springing of a mine*, new motion is certainly produced, and soon ended; and *all living creatures*, *man especially*, begin, and put an end to motion, spontaneously. Among other arguments, which prove the contrary of this assertion, it is plain that two soft, or unelastic Bodies, encountering directly, are both stop'd. Here it is observed that, " in this case, their  
 " whole motion is lost; and the motion of  
 " the one being destroyed by the opposite  
 " motion of the other, it is without ground,  
 " and merely to save an hypothesis, that  
 " *a fluid is imagined*, which they feign to  
 " receive, and retain the forces of bodies.  
 " —According to our first views of mat-  
 " ter and motion, from the *plainest experi-*  
 F 2 " *ments,*

“ *ments*, matter appears to be an *unactive*  
 “ *substance of no elasticity*. Yet they as-  
 “ cribe a perfect elasticity to all their *sub-*  
 “ *tile matter* ; and laws of motion are pro-  
 “ posed by them as general, which can  
 “ hold of perfectly elastic bodies only ;  
 “ that is, of bodies, not one of which has  
 “ hitherto been found in nature. They  
 “ have never been able to explain how this  
 “ *perfect elasticity arises from the laws of*  
 “ *mechanism* ; yet, according to them, the  
 “ world is a mechanical perpetual move-  
 “ ment (1).”

XI. Here by the way, we may observe, that if a man argues from the inactivity of matter against *Des Cartes*, why should he not make his own hypothesis consistent with the inactivity of matter ? Or will not that argument be as conclusive against a like hypothesis, as against *Des Cartes's* ? To argue from our *first views* of matter only, leaves the argument somewhat dubious ; as if afterwards might perhaps discover matter to be an active substance ; in which case, we might bid adieu to philosophy and reason. But I suppose it is meant, *according to our best or exactest views*.—However to let that pass,

as hath been said a very few lines before,  
 “ If all bodies in the world had a perfect  
 “ elasticity, there might be some pretence  
 “ for maintaining this principle,” to wit,  
 that the same quantity of motion still remained in the world, and therefore that it was a *mechanical perpetual movement* ; I would ask first, If *perfect elasticity* cannot arise from mechanism, whether *imperfect elasticity* can arise from mechanism ? Especially since matter appears from the plainest experiments to be an *unactive substance of no elasticity*. Plain experiments should determine the point. But if imperfect elasticity may arise from mechanism, it might be contended that perfect elasticity was only mechanical. If a weak degree of active power may arise from matter and motion, a strong degree of it might be owing to the same cause. And if all elasticity, *perfect* and *imperfect*, be above the laws of matter and motion ; it cannot be wrong to ascribe it to an immaterial power immediately impressed : for there is no other third cause to come in competition. This whole argument seems a little ambiguous, and only levelled against perfect elasticity.

XII. But if it be wrong in *Des Cartes* to suppose a *perfectly elastic fluid*, I would ask in the next place, if it be right to take up the same supposition under a different name? The *Cartesians* ascribe a perfect elasticity to their subtile matter; and is not a perfect elasticity ascribed to the *athereal elastic medium*, which by its impulses should produce the chief phenomena of nature? Did not *Des Cartes* imagine his subtile matter with the same view? It cannot be fair reasoning to impugn perfect elasticity in one supposition, and go into it in another supposition, just for the same purpose. There is little difference between the two *subtile matters*, either in the effects they are supposed to produce, or in the want of foundation for their existence. If *Des Cartes* had accounted for the motions of the heavenly bodies, as agreeably to the laws of geometry and mechanics, as Sir *Isaac Newton* has done, and then ascribed the whole to the impulses of a *subtile elastic matter*, there would have been no difference in the thing supposed, whatever there might have been in making the second supposition, and defending it, after the first was rejected.

And



And even then, we should have had the same reason to reject this *subtile matter*, as now. Any number of suppositions, does not make it other than an inactive substance, I am forced to say, that it seems to be the disease of philosophers to hunt after material causes. For it is very unphilosophical to suppose, that one half of matter may be employed to move the other half of it ; or to search for a cause in a substance that has no power.

XIII. As to *elasticity*, we may be demonstratively certain that it cannot be the effect of a *material cause*, since matter cannot impress a new force upon itself, after the former is spent. If two equal, unelastic bodies encounter directly, with equal celerities, the whole motion is lost on both sides, as was said before : and if they be perfectly elastic, their motion forward is as much destroyed, as if they were unelastic ; but an equal motion is produced anew, and they fly back with the same force and celerity as they came forward. It is needless so often to repeat, that a substance, which necessarily resists all change of its present state,

could not thus change its state ; and after its former motion is quite destroyed, begin again to move in an opposite direction. It is once in a state of rest, tho' short ; for it cannot move both forward and backward at once than a body projected upward, could both ascend and descend at the same time ; and between these motions, it moves no way, or it is in a state of rest. And as a body thrown up, if the impression of gravity were suspended, when it is at its height, would remain there ; so when the compressive force is spent in the shock of elastic bodies, if the restitutive force were suspended, they would both remain in contact without motion to any side. (m) The argument is

(m) No subtile matter can be pretended to reproduce the motion lost in the shock of elastic bodies. For what should determine the subtile matter to act, in a contrary direction, just when the former motion of the bodies is destroyed? A determining principle is wanting to begin the action.——Or if the subtile matter acts incessantly, why does it not stop the motion forward, as well as produce an equal motion backward? And if it acts incessantly, why is not its motion and force felt *sensibly* at all times ; as was argued with respect to gravity? The material impulse that produced a strong force, must be equally strong. It pro-

is the same, tho' the bodies be but *imperfectly elastic*. The force of restitution in  
 glaſs

produces a very ſenſible effect in two ivory balls; which ſhould repel from each other two equal balls that were at reſt, and in contact. This is a neceſſary conſequence of its acting conſtantly in a contrary direction. Or if it acted conſtantly in any direction, its action would be *felt*. We give up the teſtimony of our ſenſes too ſoon, even in caſes where they are competent judges. When a cannon, or but a muſket is diſcharged, if the ſubtile matter ruſhed that way, to drive the bullet out, it would be *heard*, as well as *felt*. Senſe itſelf becomes judge in theſe nice diſputes of philoſophers. In the ſpringing of a mine, if the ſubtile matter ruſhed forward to diſcharge that terrible force, it would do execution, before the blowing up of rocks and walls of cities. Becauſe it is called *ſubtile matter*, we inattentively allow that its force muſt be inſenſible, at the ſame time that it is ſuppoſed dreadful. And if our ſenſes thus decide againſt the patrons of *powers* in matter; they ſhould give up *elasticity*, among its other *powers*, rather than expoſe their philoſophy to be confuted by the plaineſt arguments.

If they ſay, no ſubtile matter is concerned in the reproduction of motion loſt in the ſhock of elastic bodies, or in the production of new motion, when a bomb, or cannon-bullet is thrown out with ſuch irrefiſtible force; but only that this is by repulſe between the parts of matter: it hath been ſhewn above, *that repulſe between two quiſcent bodies, or particles of any ſize, is a natural*

glass, is found to be to the compressive force, as 15 to 16 : if therefore the experiment were made with balls of glass, they would fly from each other again with 15 sixteenths of the velocity they had at first. Thus their beginning to move in a contrary direc-

natural impossibility. They should likewise remember, that multiplication of motion is as impossible to an inactive substance, as beginning of motion : for it is in effect the beginning of motion *that was not before*. It was to avoid this impossibility, that made *Des Cartes* suppose, the same quantity of motion always remaining in nature. — They who contend for this multiplication of motion by mere matter, have forgot the second law of nature, *that motion is always in proportion to the force impressed*. This directly excludes the production of new motion mechanically, or without *immaterial power*. The body, or particle A, could not impress on the body, or particle B, more force than it hath. This short argument, as I have said, is universal, and applicable to every particle of matter in the universe ; and therefore concludes more, than all the advocates for powers in matter will ever be able to shake. — It is shewing a great disregard to truth, first to own the laws of nature, in order to keep fair with the common sense of mankind ; and then to have recourse to unnatural and absurd fictions, in order to overturn them again. For this *subtile matter* is contrived on purpose to begin, and multiply motion all manner of ways.

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tion, is by a force impressed *ab extra*, as much as the descent of heavy bodies is ; tho' *elasticity* be not analogous to *gravity* in other respects.

XIV. There is therefore no difference between *perfect* and *imperfect elasticity*, with respect to their *cause*. If a body could not begin to move with any degree of celerity, it could not begin to move with a small degree, more than with a great one. It makes a proportional resistance to the one, as well as to the other.—Air is perfectly elastic, because it expands itself always with the same force wherewith it is compressed ; tho' at some times it is with more difficulty compressed than at others. Not only our sense of *bearing*, but our very vital breath, is connected with this perfect elasticity : so that in this respect, as well as innumerable others, our life depends on the power of the Creator, incessantly working our preservation, and not on the power of a dead substance.—And if perfect elasticity be, when the force of restitution is equal to the compressive force ; what name shall we give it, when the expansive force

is

is irresistibly strong, without any compression? as in the springing of mines, firing of great guns, &c. Shall we call this *more than perfect elasticity*?——It is by this *power* likewise that the Author of nature reproduces motion, constantly decreasing by the action of bodies upon bodies. The just quantity of it is thus always supplied; but it is not always the same. Elasticity exerted without any compression, is certainly *new motion*, as well as the spontaneous motions of all living creatures.——All elasticity is necessarily accompanied with *repulse*. Elastic and repulsive force are the same.

And thus all those *powers* that were formerly thought to belong to matter, without any exception, are found to be the immediate impressions of *immaterial power*. If I have argued amiss, I shall surely hear of it. Every man of common sense is judge of these arguments; and I only wish they may be impartially examined.

S E C T. IV.

*That motion cannot be increased, by resolving it into two directions. Motion is always lost in the composition of it, and never gained by resolution. Addition and subtraction of motion different from the composition and resolution of it. Our mistake concerning the effect of the inclined plane in this case. That motion should be increased mechanically, a direct impossibility.*

**T**HUS it appears that the constant decrease of motion and force in the universe, can only be repaired by *immaterial power* impressed on matter. Yet it is asserted, that “ as motion is lost in the *composition*, so it is necessarily gained in the *resolution of motion* (a).” This might pass

(a) In page 140. it is said, “ The resolution of *powers* or pressures, is a necessary consequence of their composition. As motion is lost in the *composition*, so it is necessarily gained in the *resolution of motion*. And as this is allowed of motions, and of  
“ the

pass for a *first thought*, or unguarded expression, were not arguments and demonstrations brought to support it. And as the consequences of it, if it were true, would go far, for it is asserted without any limitation; I beg leave to consider it, as necessary in the important question concerning the *inactivity of matter*. Mathematical figures, and terms of art, may impose on plain people; but if they contradict first principles, we cannot be blamed for suspecting them. And this is only an indirect way of asserting the *power of matter*, without seeming to deny its *inactivity*. If matter may multiply, or increase motion in itself mechanically, the *inertia* of matter is again overturned in a dark and hidden manner, while men appear only to be shewing a common property of mechanical motion.

“ the *powers* that generate motion, there can be no  
 “ good reason given, why it ought not to be allowed  
 “ of the effects of these powers, or of the force of  
 “ bodies.” The author says here, *it is generally allowed*, that motion is necessarily gained in the resolution of motion; which is the only thing to be proved. If it were true of motion, it would easily follow in the force of motion.

II. It



II. It is obvious to common sense, that if a body is impelled by two forces at once, in different directions, whether these two directions make an obtuse angle, a right angle, or an acute one; it must move in some middle direction between both. Any person may conceive this, by supposing two men drawing a body, by the help of two ropes, or cords: if the one draw obliquely, or side-ways to the other, the body will be moved in neither direction, but in some direction between both, and nearest to that side on which the strongest force is applied. And thus two forces are *compounded* into a third. But if the two men draw in the same direction, the two forces conspire; and the force with which the body is moved, is equal to the sum of both forces: or this is *addition* of one force to another. If the two men pull in contrary directions, the one force opposes the other; and the body is moved by the difference of the forces, towards the stronger force: and this is the *subtraction* of one force from another. This will help us to distinguish between *composition* and *addition* of forces. — In the com-  
 1 position

position of forces, the middle direction in which the body moves, will be the diagonal of a parallelogram, whose sides are in the two first directions : and if the impelling forces be as the two sides, the compounded force will be as the diagonal.

III. Thus if a body be impelled in the two directions: (*see fig. 1.*) AB and AD, from A towards B, and from A towards D; with forces as these two equal lines, it will move in the diagonal AC, with a force as AC. But if the same body be impelled by the same forces, in the directions DA and DC, it will move in the other diagonal DB; and the compounded force will be as DB. Hence if the angle made by the two directions be very obtuse, as DAB, the two forces oppose each other so much, that the compounded force AC is less than either of the compounding forces. But if the angle formed by the two directions be very acute, as ADC, the forces conspire and assist each other; so that the compounded force DB will be greater than either.—This perhaps will be clearer, if the forces are expressed by numbers. Let

the two equal forces be each of them as 9, their sum will be as 18; and if the angle BAD be 127 degrees 14 minutes, the diagonal AC will be only equal to 8; and then a force as 10 is lost in the composition. The compounded force in this case, will always be less than either of the compounding forces, as long as the angle DAB is greater than 120 degrees; and if it be 120 degrees, the force in the diagonal will be equal to the force in either of the sides. And as the angle is larger, the compounded force is still less, and less; till the two forces act in opposite directions, when the diagonal evanishes, and the whole motion is lost. But if the same forces act in the directions DA and DC (the angle DAB remaining the same) the compounded force DB, will be greater than either DA or DC; or it will be as 16,125 nearly, and a force only as  $1\frac{7}{8}$  is lost. Yet the compounded force can never be equal to both the compounding forces, till the two directions coincide. Then it is the *addition* of two forces together, and not their *composition* into a third.—And thus motion is

lost in every composition of motion, without any exception.

IV. In the *resolution* of motion, or force (for a distinction between them is affected) any force as DB, may be supposed to be compounded of two forces, as DA and DC; or of any other, that are as the two sides of a parallelogram, of which DB is the diagonal: and then we consider one of these parts only as employed on any obstacle. But that does not restore the force that was lost in the composition, or shew that the other compounding force remains entire. Or thus; the compounded force may be employed as one of the parts, but not as both together, more than the diagonal DB, can be shewn equal to the two sides DA and BA: nor can one part of it first be employed against an obstacle, and then the other; except both the body and obstacle be supposed perfectly elastic. In which case, the motion lost is again reproduced by *immaterial power*, as hath been shewn, and not by the *resolution* of motion. The compounded force cannot even be employed as any one of the parts, if both be equal,  
and

and the angle of the two directions greater than 120 degrees, as was observed. Thus the compounded force as AC, cannot be employed either as AB or AD, more than the number 8 can be equal to the number 9: and it can be employed but as the least of the compounding forces, if they are unequal.—Hence it appears that motion can never be increased mechanically, or gained by the *resolution* of motion. A general mistake in this subject, where the force is far from being mechanical, shall be taken notice of below.

V. We cannot conceive that a less motion, or weak force as AC, may be compounded of two greater motions, and that it may be *resolved* into these again. For then, since any motion may be supposed thus compounded, one of these greater motions might be supposed resolved into two yet greater; and so on. This would infer that *absolute motion* might be mechanically increased, as far as we pleased to imagine; which is magnifying the *activity of matter*, at the same time that we acknowledge it to be *inactive*. Two or three imaginary reso-

lutions would raise a weak force to a great height. Or, if the motion lost in the preceding composition, were only gained in the next resolution; it would follow that the same quantity of motion might still be kept up mechanically in the universe, without the intervention of immaterial power; which is just the *Cartesian* notion, pretended to be rejected in another place, as was shewn in the last section. So that much depends on understanding this principle of mechanics aright. For the oftner motion is compounded of other motions, the more of it must be lost; and no resolution can make up what was lost in the very last of these compositions. If gravity, elasticity, and other immaterial impressions were suspended; all the motions in nature would soon be at an end, and the universe become an *abyss* of darkness and silence.—Thus *mechanics* demonstrate to us the constant decay of motion in nature; but cannot shew us the increase of it, in any one instance. We must have recourse to a higher principle for repairing it again.

## VI. The

VI. The argument brought to shew that the quantity of *absolute motion* is increased by *resolution of motion*, is because the *sum* of the motions (*see fig. 2.*) A B and A D, or B C, in the sides of the parallelogram, is greater than the motion A C in the diagonal (*b*). But this rather shews, that motion is lost in the composition, than that it is gained in the resolution of forces. And again it is said, “ If from the motion A C “ in the diagonal, you subduct the motion “ A D in one of the sides, there will remain the motion A B in the other side “ of the parallelogram A B C D (*c*).” One of these places directly contradicts the other. If the diagonal be less than the sum of the sides, according to the first place; how can it be equal to them both? as it is said in the second.—Besides, since the force in the diagonal is supposed equal to the forces in both the sides, and if from that force, you suppose the force in one of the sides

(*b*) In page 123. it is said, “ It appears likewise how “ *absolute motion* is lost in the composition of motion; “ —While on the contrary, in the *resolution* of motion, the quantity of *absolute motion* is increased; the “ *sum* of the motions A B and A D, or B C, being “ greater than the motion A C.” (*c*) Ibidem.

taken away, it is inferred that the force in the other side will still remain ; or since a *sum* and *remainder* are here supposed as *mediums* of proof, it is plain that *addition* of forces is taken for the composition of them ; and then the subtraction is made, as if that were a just way of reckoning. This is a great mistake in the theory of the composition and resolution of forces, and must lead into great errors ; especially as the argument is here without any restriction, and applied to all parallelograms in general. Even in rectangular parallelograms, as in the author's figure here, the compounding forces, as 6 and 8, are greater than 10, the compounded force : and if from the motion or force as 10 in the diagonal AC, you subtract the motion AB as 6, there will not remain a force as AD equal to 8 ; more than 10 can be equal to 6 and 8.

VII. Here it is not a just way of reasoning to suppose the bodies unelastic when we consider *composition*, and elastic when we consider *resolution* of motion. This must lead us into a false notion, as the motion produced again by elasticity, cannot be supposed gained by the mechanical resolution



tion of motion. When an elastic body impinges on a firm obstacle perpendicularly, where its force is not divided, and cannot be resolved into two directions ; motion is reproduced, for it rebounds perpendicularly, which cannot be ascribed to resolution. It was shewn before, that neither *perfect*, nor *imperfect elasticity*, can arise from mechanism ; not to mention that this was argued against the *Cartesians*, in the place there cited, when it was said that *matter appears to be an inactive substance of no elasticity*.——This shews us how the case is in the oblique illifion of elastic bodies. If A, in the same figure, be a body perfectly elastic, and if it strike against a firm obstacle at C, it will rebound to E, CE being equal to A C ; because the motion lost in the shock, as A B, is reproduced by the force of restitution. But if the body hath no elasticity, it cannot rise again from the direction BC in any manner. That part of the compounded motion therefore arising from the force A B, is quite lost in the resolution. And if A be but imperfectly elastic, it will not rise to E, but fall lower towards G : so that still motion is lost in the resolution, in proportion as the

G 4
force

force of restitution, which should reproduce it, is less,

VIII. There is an experiment offered, to demonstrate that motion is gained in the resolution of forces; which is represented in this figure (*see fig. 3.*) Here the three bodies C, B, and A are supposed equal, and perfectly elastic: the body C is impelled by two forces, in the directions D L, D K, and supposed to move with the compounded force in the Diagonal D C, where it impinges on the two bodies A and B obliquely. To A it communicates the motion C A, equal to K C, and in the same direction; and to B the motion as B C, equal to L C, and in the direction L C. And thus *absolute motion* is increased in the resolution of motion.

—But it appears to me very inconsistent, first to own that *perfect elasticity* cannot arise from mechanism; and then to contend that motion is mechanically increased by bodies perfectly elastic. For it is said,  
 “ We have supposed the bodies C, A and  
 “ B to be *perfectly elastic*, in conformity to  
 “ the supposition of our opponents, some  
 “ of whom confine themselves, in their enquiries,

quiries, to these only(*d*).” A worse reason than this, I think, could not be given, for a man’s being inconsistent with himself.—Who these *opponents* are does not appear. If both sides contend, *that motion is mechanically increased in the universe*, they cannot be said to be opponents. And, at any rate, we should argue consistently with ourselves, oppose us who will.—But this experiment is only imaginary, and cannot succeed on trial, so as to shew motion mechanically increased.

IX. For first let C be a body perfectly hard, or unelastic, whose matter let be equal to 1, and let its velocity DC be 3; and let the matter in A and B be supposed in one body, also perfectly unelastic, which will be as 2, each of them being equal to C. Then C impelling the double body A + B directly, with a moment or force as 3, they must move on in contact in the direction CF, with a velocity as 1; since their matter is as 3. And in this case there can be no motion gained.—Then let the bodies A and B be considered as separate, and im-

(*d*) Page 141.

elled

pedd obliquely in the directions CA and CB, by the body C, moving with the same velocity as 3; and it can impart to them no more force than before; because the matter to be moved is the same, and the force to move it is the same. Therefore the three bodies A, B, and C, will move on in the three different directions, CA, CB, and CF, each with a velocity as 1: or if C be supposed to stand still after the impact, it will communicate the half of its force and velocity to A, and the other half to B; in either of which cases, the motion or force is still as 3. So that in this resolution there is no force gained.

X. Next let all the three bodies be supposed perfectly elastic, and then the effects of the shock, or changes produced in the state of the bodies, must be double of what they were in the former cases; which will help us to compute their forces with certainty. For when A and B are supposed to be in one Body, it will be impelled with a velocity as 2 in the direction CF, and its force will be as 4: But C will fly back with a velocity and moment as 1, according

cording to the law of elastic bodies, or of the center of gravity ; and  $4 - 1 = 3$ , will be the motion to the same side. This is the gaining of motion in the shock of elastic bodies, and not by the resolution of motion ; for there is no resolution in this case.

—Then if A and B be separate bodies, A will be impelled in the direction CA, and B in the direction CB, each with a velocity as 2 ; and C will rebound with a velocity as 1 : for it cannot stop at the point of impact, when it strikes on a double elastic body, but must fly back, as if repelled in the directions AC and BC ; or it must rebound in the middle direction CD. And still the motion to one side is  $4 - 1 = 3$ , as before.—

Thus when we compute the forces according to the uncontroverted rules, we see the increase of force is owing to the elasticity of the bodies : for when they are supposed without elasticity, the motion is no way increased. And even tho' they are supposed perfectly elastic, the author's reasoning is wrong. If LDHC be a square, the square of DC the diagonal will be 9 ; and LC or KC (that is, AC or BC) will each be equal to  $\sqrt{4, 5}$ , which is more than 2,

OF

or than the law of elastic bodies requires. If the angle at D be obtuse, DC remaining the same, LC and KC will still be greater: and if that angle be considerably acute, the forces communicated, as LC and KC, will be less than the law of elastic bodies requires.—Moreover, he supposes the body C to impart one half of its motion to A, and afterwards the remaining part to B; so that it must stand still after impact (e). Which is very like *Leibnitz* and *Bernouilli*'s reasoning, whom yet he pretends to be his opponents: on which account he thought it a matter of indifference to argue from elastic, or unelastic bodies.

XI. After this experiment, an objection to it is answered thus. “ If it be objected, “ that in this case, the motion of C in the “ direction DC, is the Cause of the motions of A and B, in the directions CA and “ CB; so that the *cause* produces *effects*, “ whose sum is greater than itself: In answer to this, we have already observed, “ that as this is allowed on all hands of

(e) See page 141. from these words, “ Suppose the “ body C first to strike upon A, &c.

“ motions and pressures, it cannot be absurd  
 “ to extend it to forces, but must obtain in  
 “ them for the same reason.” (f) All that  
 needs be said to this is, that the author him-  
 self here unwarily enough allows, *that*  
*the effect may be greater than its cause.* No  
 body else allows it, who argues rationally.  
 The atheist knows well how to use this ad-  
 vantage ; which, granted in any one case,  
 becomes universal ; for the allowing it, is  
 giving up natural religion all at once. If  
 the author had been pleased to consider fairly  
 what was said in the First part of the En-  
 quiry, concerning *elasticity* and *gravity*, he  
 had not been brought into this strait : It is  
 being reduced to great distress, when, rather  
 than own, that immaterial power immedi-  
 ately impressed on matter, reproduces mo-  
 tion, constantly decaying in the universe,  
 we allow, *that the effect may be greater*  
*than its cause.*——We have already seen  
 what share elasticity hath in reproducing  
 motion : I shall next consider a particular  
 case of gravity, which leads people wrong in  
 this subject,

(f) Ibidem.

XII. It

XII. It was observed above, that there is a general mistake with respect to this subject, when we argue from *immaterial power* constantly impressed, as if that were mechanical force, or the effect of *the resolution* of motion. This I shall consider by way of an objection to what I have said in as few words as is consistent with understanding the case fully. It will help us to get over a very common prejudice.—It may be said, when a body as D, is supported by an inclined plane, the whole weight of the body is represented by the length of the plane as A C : ( *see fig. 4.* ) and by being thus supported, the force is *resolved* into two parts acting in two directions ; and the two parts are as the sides of the triangle, A B and B C. So that the force in the diagonal of the parallelogram, is really equal to both the forces which are as the sides of it. Thus if the length of the plane A C be 13, and the height of it A B be 5, the base of it B C must be 12 : and if the body D weigh 13 pound, the plane supports a part of that weight as 12 pound ; and it requires besides a force as 5 pound, to keep it from rolling



rolling down the plane: nor will a less force hinder its descent. And thus a force as 13, is *resolved* into parts as 12 and 5.——This is an imposing appearance, and looks like a proof of what is contended for: and yet when examined fairly, nothing shews the contrary to more satisfaction.

XIII. For here we are to observe, that with respect to the mechanical increase of motion, we can as little argue from gravity, as from elasticity. Both these forces are immediately impressed *ab extra* upon matter, and nothing like mechanical. Gravity is a constant repetition of impulses, where new force is continually impressed on a body by an immaterial cause: And it would be unskilfulness, to argue from a force constantly renewed, to a force impressed by one single impulse. A force impressed by one single impulse, as when a ball is struck, is stopt instantly by a resistance equal to it, as when the ball strikes against a firm obstacle: But the constant impression of new force on a heavy body, produces a greater and constant effect; or the resistance must be as constant as the impres-

impression. It is this that makes the additional force of 5 pound weight, necessary to keep the body from rolling down the plane.—Gravity, I say, is a continued renewing of force, and increase of motion. We see the farther a body falls, it has the more force and celerity, from the greater number of impulses: But a body has not the more force, or greater celerity, the farther it moves in an horizontal direction. So that we cannot contend for an increase of force and motion from one single impulse, because motion is increased by a constant succession of impulses.—We have here then an increase of motion, previous to its being *resolved* into two directions; and it would be the effect of a surprise upon us, to allow that *this increase* was owing to the mechanical resolution of motion, when we see it constant, and previous to any resolution. The *resolution* in this case, only makes the incessant impression of new force the more apparent, by the inclination of the plane. For the impression of gravity is as incessantly renewed, when the body is supported on this plane, and at rest, as if it fell downward. A body that lies on the ground presses

presses downward constantly, and with equal force. If a body weighs 13 pound, it would be a strange miracle, if we caught it sometimes weighing less, sometimes more, and sometimes nothing at all. Now the *inclination* of the plane, since it does not oppose the force of gravity directly, leaves it room to exert itself by halves, if I may so say: just as a body changes its direction by an oblique impact. And the direction of gravity is thus constantly changed; or the direction of every impulse is changed.

XIV. For if we suppose that these impulses were suspended, or that no new force were impressed on the body, after it began to move with a moment as 13; a contrary force then as 13 would stop it: nor would any additional force be necessary after that, to hinder it from moving on; there being no new impulses to have their direction changed, by the obliquity of the plane to the horizon. This makes the case very obvious; for on that supposition, the inclination of the plane would have no more effect, than if it were horizontal.—Or let us take it  
H thus:

thus : If a body receives but one impulse, which communicates to it a force as 13 ; its direction can be changed but once, by any oblique obstacle ; and it will move on afterward in that direction, without any tendency to change its direction a second time. That is impossible to the *inertia* of bodies ; and if it be stopt, it rests there, without any thing to retain it in that part. But if it receive a second impulse in the former direction, that direction must be changed a second time, and it will move on as before, unless it be retained. And if it receives a third impulse, in the same direction still, the oblique obstacle will change that direction a third time ; and it must be retained from moving along that plane a third time ; and so on for ever. And if the impulses are very frequent, the body must be as frequently stopt from moving on : and if they are constant, it must be constantly stopt.

XV. This is just the case of the *inclined plane* analysed (if I may so say) ; for the impulses of gravity perpendicular to the horizon, are indefinient, and their direction  
is

is indefinitely changed by the obliquity of the plane, and the body must be indefinitely stopt, or retained constantly from rolling along, in consequence of this constant change of direction.—And since the relative gravity of the body on the plane, or its tendency to roll downward, is always as the height of the plane  $AB$ , or as the sine of the angle of the inclination of the plane; and the resistance of the plane, or that part of the weight which the plane sustains, is as the co-sine of the inclination, or the horizontal line  $BC$ ; since this is so, I say, we thus see, that it is the constant impression of new force, that makes the force in the diagonal  $AC$ , equal to the forces in the two sides of the parallelogram,  $AB$  and  $BC$ ; and that this is impossible, where there is but one impulse. For when we suppose the subsequent impulses suspended, the inclination of the plane has no more effect to change the direction, than if it were horizontal; the denominations of *downward* and *upward* become then improper: and the body could not change the direction of its motion of itself, without a new force impressed upon it in a different direction.—

We inadvertently think that a body on an inclined plane has a tendency to move two ways at once. This is a simple impossibility. Nor would it constantly tend to leave the direction it moves in, and turn another way, except by a *living force* incessantly renewed upon it, as is gravity. In any other case, if a body be diverted in its course by any obstacle, it takes a new direction, without any tendency to return to its first direction. But a body rolling down an inclined plane, or projected obliquely upward, is always impelled to change its course, and move perpendicularly downward, and it follows these impulses as much as possible. Which shews us the difference between a *living force* constantly renewed, and any other force but once impressed. How easy were it for philosophers to shew us in a demonstrative way, the hand of the *living God* constantly working in nature, if they would not hunt after material causes ! Instead of allowing effects to be greater than their causes, they would thus see the *only cause* adequate to all the appearances in nature.

A strong

Fig. 1.

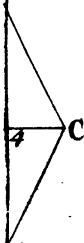


Fig. 2.

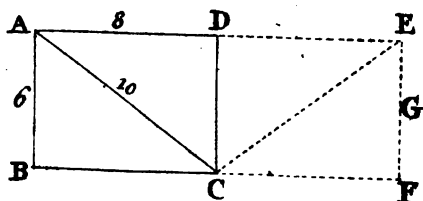


Fig. 3.

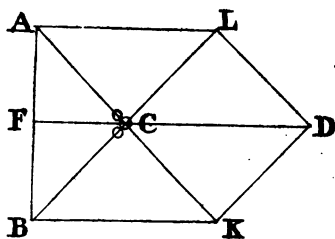
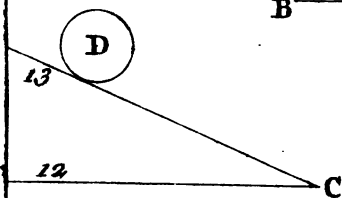
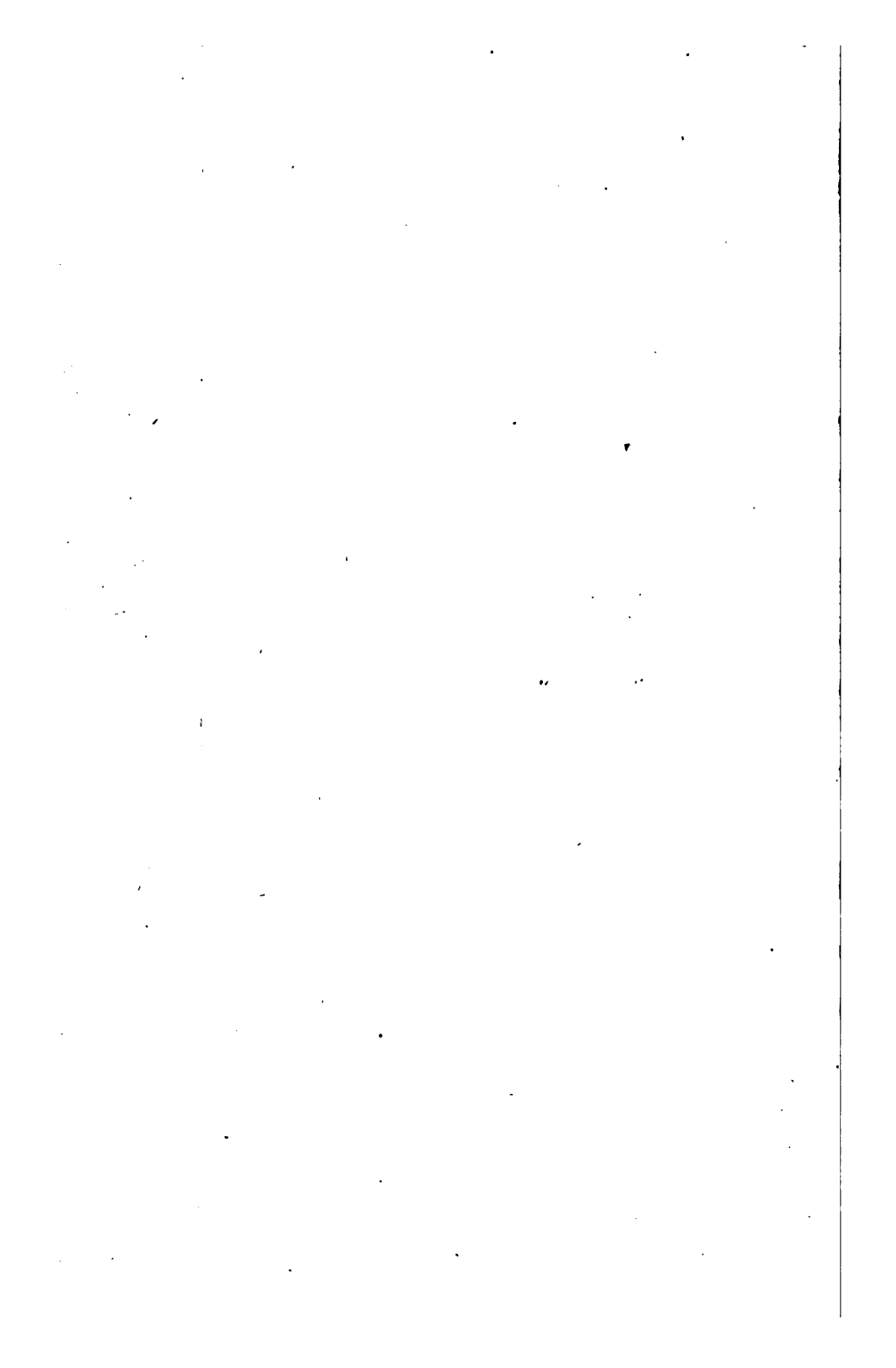


Fig. 4.







A strong desire to set this important truth in a just light, will plead my excuse for being so particular on this subject of renewing motion. No matter can come in for a share in the effect, if I have reasoned right. The considerations offered on this last head, are applicable to bodies suspended by cords, or supported by forces acting in different directions ; or wherever the impression of gravity produces the effect.

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## S E C T. V.

*The true end of enquiring into the works of nature, and the constitution of the universe. The low artifice of extolling the Deity in words, and derogating from his perfections in facts, of supposing the government of the Deity in the material world, instead of proving it. Of removing him out of sight, by a series of unknown second causes. That the Argument from final causes for the existence of the Deity, can only be rendered less convincing by supposing that dead matter can execute the design, and perform the art. Of arguments à priori unfairly judged of: an argument à priori given. The necessity of space and duration consequent only on the existence of a Necessary Being.*

**T**HE last chapter of this work is concerning the Deity, and his government of the material world. Let me be permitted to endeavour to set right what appears most exceptionable in it, as a great deal

deal is exceptionable. The intelligent reader will then determine, whether the principles laid down in the first part of the *Enquiry*, or those substituted in this chapter, concerning the government of the material universe, be most conformable to truth. This liberty I expect others will take with me, and I do not refuse it. I contended there against no person, but for what I sincerely thought, and still think to be the truth; and since these reasons are excepted to, I cannot be blamed for considering the whole again, so as to shew on which side the truth lies.

II. The chapter begins thus, “ *Aristotle* concludes his treatise *De Mundo*, with observing that to treat of the world, without saying any thing of its Author, would be impious; as there is nothing we meet with more frequently, and constantly in nature, than the traces of an all-governing Deity.”—The true end of all philosophy (as hath been said above) is to discover a Deity and his perfections. We cannot name any other justifiable design of enquiring into the constitution of the universe.

A natural desire of knowledge prompts us to enquire. We meet with inimitable *art* and *power*, which raises our wonder. The same desire prompts us to consider to whom this *art* and *power* belongs. We cannot help assigning, in our own minds, some *cause* or other, of what we so much admire. And the assigning a wrong cause (even *blind chance*, *fatal necessity*, or *dead matter*,) has given rise to all the absurdities we meet with in natural philosophy, from the earliest times. So that, as I said, to discover the Author of those works, and his perfections, is the only justifiable *end* one can think of, for inquiring into the works, of nature. No man will own that his view is, merely to be reckoned learned: if that be his view, and if he attains it any way, he will be indifferent about *truth*. The reputation of learning is often given to the defending of absurdities. And providing for the necessities of life is easily done from experience, without much abstract science. Others can assign their own *ends* of study.—But this being allowed, it seems too late to speak of the *contriver* and governour of the world, at the end of our enquiry into his works.

works. His *power* and *wisdom* are best seen, while we are considering the effects they produce. These effects (not the bare *traces* only) are plainly to be seen every where : and to delay the ascribing them to their proper cause, till our attention to them ceases, or is engaged another way, cannot carry home so familiar a conviction ; tho' it may serve to keep up *Aristotle's form*.——

The better method therefore, I think, is to examine as we go along, whether the wonders we contemplate, can be wrought by any thing but *infinite power*, conducted by *infinite wisdom* : and to institute a comparison in every particular, between *Omni-potence* and *dead matter*. Dead matter always engages *chance* and *necessity*, in opposition to *wisdom* and *liberty* ; so that the decision is easy.

III. What is observed a little after of *Spinoza*, is much to the purpose. “ *Spinoza*, while he carried the doctrine of “ *absolute necessity* to the most monstrous “ height, and surpassed all others in the “ weakness of his proofs, as well as the “ impiety of his doctrine ; yet affects to “ speak,

“ speak, on several occasions, in the highest  
 “ terms of veneration for the Deity.” This  
 is a just censure on this irreligious writer.  
 It is not right to exalt the Deity in words,  
 and derogate from his perfections in facts.  
 This is only paying him a compliment, and  
 then setting aside his government in whole,  
 or in part : a stale artifice. *Cicero* objects  
 this low cunning to *Epicurus*, when he says  
 it is *verbis ponere, re tollere*. *Lucretius* en-  
 deavours to vindicate *Epicurus*’s scheme  
 from irreligion, because he had spoke mag-  
 nificently of the Deity, in several places:  
 as if that were enough to make a false  
 doctrine as conducive to virtue among men,  
 as true and rational principles. *Des Cartes*,  
 before *Spinoza*, had given the government  
 of the universe to matter and motion. And  
*Leibnitz*, under a pretence of extolling the  
 original contrivance of things, leaves the  
 execution of all to this dead substance. Ac-  
 cording to all these schemes, we see no-  
 thing that the Deity does now : we behold  
 only the operations of matter. This fills  
 the mind with anxious doubts. If matter  
 performs all that is wonderful in nature, it  
 catches our first admiration ; and we know

not where to search for the being, who contrived that which we see matter executes with such dexterity.——It is true he is called the *first cause*, the *supreme*, the *independent cause*, the *first mover* : But these titles point at something so distant, and there are so many *other causes* laid in the way, that our views cannot reach so far, In examining the several *series* of these causes, our sight fails, and we are forced to give over disappointed ; or death prevents us, as it has done all men hitherto in this search. This, I think, is a grievous mistake in our philosophical enquiries, which we are all apt to fall into, while we stick tenaciously to our material hypotheses. While therefore we acknowledge the Deity in words, and magnify his perfections ; all our arguments should be agreeable to this confession. This is like practice, the other like profession only.

IV. A little after it is said, “ but Sir  
 “ *Isaac Newton* was eminently distinguished  
 “ for his caution and circumspection, in  
 “ speaking and treating of this subject, in  
 “ discourse, as well as in his writings ; tho’  
 “ he has not escaped the reproach of his ad-  
 “ versaries,

“ versaries, even in this respect. As the  
 “ Deity is the *supreme* and *first cause*, from  
 “ whom *all other causes* derive their whole  
 “ force and energy ; so he thought it most  
 “ unaccountable to *exclude him only* out of  
 “ the universe. It appeared to him much  
 “ more just and reasonable, to *suppose* that  
 “ the *whole chain of causes*, or the *several*  
 “ *series of them*, should center in him, as  
 “ their source, and fountain ; and the whole  
 “ system appear depending upon him, the  
 “ *only independent cause.*”——Sir *Isaac*  
*Newton* was a great and good man. His phi-  
 losophy is the sure basis of natural religion.  
 This is due to his memory, without affecta-  
 tion. But was he not too cautious, in not  
 ascribing the most noble phænomena in  
 nature, to the immediate operation of the  
 Deity, when he could find nothing else to  
 ascribe them to, but a *subtile elastic medium*,  
 of the reality of which he owns he had no  
 proof ? The candid will see that I make this  
 exception not willingly. He was the first  
 who opened the eyes of the world, by esta-  
 blishing the true system of nature, and de-  
 monstrating the law of gravity, which is  
 the constant and undeniable evidence of the



immediate influence of the Deity in the material universe. He never opposed that principle formally, or farther than by a *Quare*, which he left to the determination of others. It is now opposed, as if from his authority, or as if he had declared against it. This is an injury done to his memory, as I said before, and does no service to the cause it is brought to support.—As to what is subjoined, that it appeared to him much more just and reasonable, to *suppose that the whole chain of causes, or the several series of them should center in him*, I take it to be an unwary expression of this author. One cannot imagine that Sir *Isaac Newton* went only on supposition, in such a subject. We should be careful in expressing another man's meaning, lest we wrest it. To suppose a thing which is capable of innumerable and clear proofs, is by far too little. The Deity is not only at the head of nature, but in every part of it. A *chain of material causes* betwixt the Deity and the effect produced, and much more a *series of them*, is such a supposition, as would conceal the Deity from the knowledge of mortals for ever. We might search for matter above  
matter ;

matter ; till we were lost in a labyrinth, out of which no philosopher ever yet found his way.——We should be told something certain, or where the chain begins : for what is only supposed, is as easily denied.——This way of bringing in *second causes*, is borrowed from the government of the moral world, where *free agents* act a part : But it is very improperly applied to the material universe, where matter and motion only (or *mechanism*, as it is called) comes in competition with the Deity (a).

#### V. This

(a) With respect to the passage last cited, it is said some pages after (page 387.) “ We have observed above, that as the Deity is the *first* and *supreme cause* of all things, so it is most unaccountable to *exclude him out of nature*, and represent him as an *intelligentia extramundana*. On the contrary, it is most natural to suppose him the chief mover throughout the whole universe, and that all other *causes* are dependent upon him : and conformable to this is the result of all our enquiries into nature, where we are always meeting with *powers* that surpass mere mechanism, or the effects of matter and motion.” This place makes me suspect, that Sir *Isaac Newton*’s sense is not justly represented in the place cited above : for this is resting the whole affair still upon *supposition*, instead of certainty. It is only telling us one’s opinion, *what it*  
is

V. This sort of reasoning has no good effect upon that which is otherwise conclusive.

*is most reasonable to suppose.* But have we nothing more than *supposition*, for not excluding the Deity out of nature? This is a precarious foundation of such an important point; and really hurts the interest we should promote, if natural religion be our care. The peasant has more security than the philosopher. This is a poor reward of study. It is said, we are always meeting with *powers* that surpass *mere mechanism*: but instead of naming any of them, we are told that *gravity*, and all sorts of attraction analogous to gravity (which are still called *powers*) are supposed to arise from the impulses of a subtile, æthereal medium diffused over the universe. Which is just saying, that these *powers*, which surpass mechanism, may be the effects of matter and motion. Certainly this does not shew, that those who assert (and offer reasons for it) that the Deity acts immediately on all the parts of matter, have laid open the fallacy of the scheme, and reduced it to an absurdity, while they vainly imagined that they had compleated it.—Immediately after it is added, “The laws of nature are constant and regular, and *for ought we know*, all of them may be resolved into *one general and extensive power*: but this *power* itself derives its properties and efficacy, not from mechanism, but, *in a great measure*, from the immediate influence of *the first mover*.” This place is strangely worded, and leaves the mind in great uncertainty. What may  
be,

five. It is very rightly said afterward,  
 “ the plain argument for the existence of a  
 “ Deity

*be*, for ought we know, *may not be*, for ought we know; and thus we are sent to an *unknown power*, which, *in a great measure* only, derives its properties and efficacy from the immediate influences of the *first mover*. Shall we never know any thing, on which the immediate influences of the Deity are exerted? This indeed renders those influences uncertain, till the *unknown power* is first discovered. Had it not been better to have reasoned a little, than to have written in this ambiguous and unsatisfying manner? To have shewn the weakness of the arguments, from which the immediate influence of the Deity on all matter is concluded, than only to have suggested *that the scheme is fallacious*, and to have substituted nothing in its place, but suppositions, and conjectures about an *unknown power*? This is far from the candour of a fair enquirer.—But what can this *power* derive the rest of its properties and efficacy from? It is said *in a great measure* only. As was observed just now, nothing comes in competition with the Deity in the government of the material world, but matter and motion. Those who have endeavoured to *exclude the Deity out of nature*, never pretended any thing else. That which derives its efficacy from such a dead cause, cannot be a *power*. A *power* always belongs to something living. I am afraid the thought concerning the efficacy of this *power*, will not bear to be explained. It derives part of its efficacy from the Deity, and the rest from matter and motion, or really

“ Deity, obvious to all, and carrying ir-  
 “ resistible conviction with it, is from the  
 “ evident contrivance and fitness of things  
 “ to one another, which we meet with  
 “ through all the parts of the universe.  
 “ There is no need of nice or subtile rea-  
 “ soning in this matter ; a manifest con-  
 “ trivance immediately suggests a contriver.  
 “ It strikes like a sensation, and artful rea-  
 “ sonings against it may puzzle us, but it  
 “ is without shaking our belief. No per-  
 “ son, for example, who knows the prin-

really from nothing at all.—A little after it is said,  
 “ The power of gravity seems to surpass mere mecha-  
 “ nism.” Great caution is used all along, not to de-  
 termine any thing concerning the cause of gravity.  
 Shall we think that the author had a mind to please two  
 opposite parties, and reconcile contradictions? It is  
 a hard case, when of two contrary things, we will not  
 say the one, and dare not say the other ; and yet to be  
 forced half to deny, and half to confess them both, by  
 turns. Thus, those who assert that gravity is owing  
 to immaterial power, constantly impressed on matter,  
 hurt those very interests they would promote ; and on  
 the other hand the power of gravity seems to be above  
 mere mechanism : Again, gravity may arise from the  
 impulses of a subtile æthereal matter ; and at the same  
 time, it surpasses the effects of matter and motion.  
 This *subtile matter* is bought very dear !

“ ciples of opticks, and the structure of  
 “ the eye, can believe that it is formed  
 “ without skill in that science; or that the  
 “ ear was formed without the knowledge  
 “ of sounds.” (b)——This is a just argument, and forces our assent. The Author of the eye, not only has skill in optics, but is the fountain of that science. From his works it is that we derive the little we know in the wonders of vision: and it is so in all the other parts of knowledge. All our boasted experiments are but poor imitations of Divine art. To say, *the Deity has skill*, is a vast diminution of truth. Our science disappears before infinity of knowledge. ——But we should not weaken this conviction from *final causes*, by supposing that matter can perform such wonders; or that the Author of nature only contrived the art, and left the execution to a *dead substance*; or that a *subtile fluid* does all that is most noble in nature. To suppose that dead matter can observe the rules of optics, and form an eye, is almost as unwarrantable, as to suppose that dead matter might have formed an eye at first. The first of these

(b) Page 381.

sup-

suppositions leads men to the last. *That effect* is as impossible to matter now, as it was several thousand years ago. It was from supposing that dead matter could perform such wonders, that the Deity came to be excluded out of nature; and that men are willing now to take him in again *by supposition*. Have we forgot *Leibnitz*, who extolled the original skill in the contrivance of things, as much as ever man did? It was to bring in a *necessary chain of causes*, and to leave the execution of all that art to matter, which he supposed could not go wrong, tho' left to itself. Such reasonings as these, gave rise to the severe, but just distinction, *verbis ponere, re tollere*, as was observed above. We thus inconsistently depreciate the *Divine art* in one respect, while we seem to exalt it in another: we vilify it, by supposing matter can do the same things, and only extoll what was done many thousand years since.

VI. We ought not therefore to ascribe the original contrivance to a *cause wise and powerful*, and the performance to a *cause blind and impotent*. The one part of this

reasoning is directly repugnant to the other : The performance requires knowledge, as much as the contrivance at first. If an ingenious man sees an artist do a fine piece of work, he might possibly imitate it afterward, in some sort : but it is repugnant to common sense to suppose, that the materials themselves, the wood, or the brass, or the ivory, should do the same thing for ever after, and to as great perfection. What strange things do philosophers imagine ! for the two cases are precisely the same, as to the absurdity. — To say, the Deity interposes, when he sees that matter would go wrong, is the same thing in other words, as owning that he interposes always, if that were proper. Every particle of matter resists a change of its present state, and therefore could not effect a change of state in itself, nor in other particles. Every particle therefore would still go wrong. — Not to speak at present of forming an eye, or the organs of hearing, or an animal-body, or maintaining the circulation ; because philosophers imagine that a multitude of difficulties makes the thing easier : not to speak of these, I say, at present ; how could a body moving in a circle, or any  
curve



curve that returns upon itself, change the direction of its motion in every point ; for that is to change the present state of its motion ? This is the case of all the celestial bodies. Or how could the subtile matter, which is supposed to cause gravity, know to impell bodies to a center, with quadruple force at half the distance ? There is no subterfuge, when the difficulties are proposed singly and apart. But we think absurdities cease to be such, or that they cannot be discovered, when they become innumerable, or exceed our comprehension. And indeed then they appear all in confusion, so that the one obscures the other : and thus they have hitherto lurked, because we could not fix on one without engaging another. Besides, as to the constant interposition of the Deity, does not the cohesion of the parts of matter (whereby the least particles make the strongest resistance to any force that would separate them) shew his immediate power constantly put forth throughout all nature ? Those who are willing to receive the Deity into nature again, *by supposition*, should never forget this. As was remarked before, it would be a ridiculous fancy, to deny that a

house was inhabited, while the inhabitants were speaking to us from within.

VII. Or if we suppose the Deity guiding one sort of matter, by another sort of matter, which wants itself to be guided; and that by yet another sort; and so on; the first of which matters we are still in the dark about; for this is what is meant by a *chain of second causes*: This may appear a very ingenious conceit to us, but it is very unartful to suppose the Deity employing one part of matter to move, or direct another part of it; the greater part to move the less. For the subtile matter, said to be diffused over the universe, must be every where as dense, as where it impells the densest bodies (as where it impells lead or gold.) What a mass would this amount to through all the celestial spaces, in respect of the matter to be moved! It would not be more unartful, if we should suppose a mighty beam employed, to move a body of an ounce weight. This is against Divine art, where *dead force* is never employed, but *living power*. It is a strange, childish prejudice, to suppose the Deity employing his own power at second hand! the notion is as contradictory, as if he borrowed

rowed from himself. And yet this is implied, in all subtle matters, or when we speak of *second movers*; or call him, by way of distinction, the *first mover*. What is meant when it is allowed, "that he is *equally active and present every where?*"

(c) Men are forced to confess this. If he were excluded out of any place, if I durst to say so, that would be a chasm in his necessary existence, as much as if he were excluded out of any portion of duration. We talk of *excluding the Deity out of nature*, without knowing the contradiction of the expression. And if the Deity can be excluded from no part of nature, if he is *equally active and present every where*; why do we limit his action to *subtile matters* of our own contrivance? Is he only active at a distance, to save his being active in this place? Or is his power exerted here, to produce an effect in another place? This is a very unphilosophical confinement of infinite power. Or if he acts on all matter, does he only impress the power, undirected by wisdom and knowledge? Does the power belong to the Deity, and the art to matter? This is as

(c) Page 381. *ubi ante.*

unskilfull a division, as the former was a limitation. And if both the *power* and *art* belong immediately to the Deity, what is left for a subtile matter to perform? How can it produce *the chief, the most noble phænomena in nature*, as is asserted? The original contrivance in the works of creation, is repeated in every production. Can matter do this? Can it copy the fitness of things to each other so exactly? The original contrivance is adorable. We are certain, demonstratively certain, that it is the work of the living God: but it is the present performance that *strikes us like a sensation*. This is at once both demonstration and experiment. A sensation in the literal sense. The inexpressible pleasure to see creating power with our eyes! We see creating power directed by infinite knowledge, in every new production. We live by it.—To leave this, of which more by and by. Nothing certainly can hurt the conviction, arising from *final causes*, so much, as supposing that matter can imitate the contrivances of Divine wisdom, so correctly, that the one may be taken for the other. This, and the other consequences I have named, are  
shock-

shocking to the last degree : but why should our fondness for a *subtile unknown matter*, put it in any man's power, to deduce such consequences fairly from what we suppose? When we acknowledge the Deity to be *equally active and equally present everywhere*, as acknowledge it we must ; why after that do we limit his activity, so as to make it suit with our hypotheses? How can he not act upon all matter in the universe? Or why should he act only upon such matter as is but conjectural? Is not this to make his *activity* and *presence* only conjectural.

VIII. Nor should we so insist upon any one demonstration of the existence of the Deity (for there are innumerable) as to lessen the conviction arising from others. Demonstration from abstract reason, and the nature of things, when once we see it, gives conviction universally. This is the case in geometry and algebra. Proof from experiments is more obvious, and fitted to all capacities. We have both sorts of proof for the existence of the Deity. With respect to this it is said, " His existence and his " attributes, are in a sensible and satisfactory

" tory manner, displayed to us in his works:  
 " but his *essence* is unfathomable. From  
 " our existence, and that of other contin-  
 " gent beings around us, we conclude that  
 " there is a *first cause*, whose existence  
 " must be necessary, and independent of  
 " any other Being: but it is only *à posteri-*  
 " *ori*, that we can infer the necessity of  
 " his existence; and not in the same man-  
 " ner that we deduce the necessity of an  
 " *eternal truth in geometry*, or the property  
 " of a figure from its essence. Nor is it  
 " even with that direct self-evidence, which  
 " we have for the necessary existence of  
 " space. We mention this only, to do  
 " justice to Sir *Isaac Newton's* notion, when  
 " he suggests, that the necessary existence  
 " of space, is relative of the necessary  
 " existence of the Deity." (d)—This ani-  
 " madversion on arguments *à priori* was made,  
 when Sir *Isaac Newton's* notion of space  
 was no way in the question; nor does that  
 notion want such an apology. If the argu-  
 ments *à priori* were inconclusive, it would  
 be right to shew in what respect, and to  
 correct the error. Truth does not want  
 pious frauds to support it. But as was ar-

gued then, it is needless to insist on the difference between demonstration *à priori*, and *à posteriori*, unless truth were less certain in the one method than in the other. The comparison here serves only to raise a suspicion against both sorts of arguments, in as much as geometrical demonstration is preferred to both : and yet there is no difference made, even by mathematicians, between the certainty of the *synthetic* and *analytic* methods. The existence and perfections of the Deity shine out with wonderful clearness in his works, to the inexpressible delight of all rational beings : but it seems very inconsiderate in a man, to refer only to his works, after supposing that a *subtile matter* may produce the chief phenomena in nature.

IX. Possibly the author hath not considered, with due attention, the demonstrations *à priori* for the existence of the Deity. There must be *effects*, that is, there must be rational and contingent beings created, before they can reason in either method, concerning the Deity, or concerning any thing else. But the necessity of an *infinitely perfect intelligent Being*, is demonstrable with-

out attending to any effects; even from the necessity of *eternal truth in geometry*, or in other abstract sciences.—Truth has a necessary and immutable nature, from eternity to eternity, only with respect to an immutable and eternal *Intellect*, or *Mind*, where it was immutable and eternal: that is, with respect only to a *necessary intelligent being*. Truth is not a being existing by itself: And therefore the immutable, necessary nature of truth, must be referred to some being existing by itself, and existing immutably and eternally. But this being, to which the nature of truth must be referred, cannot be any *furd*, or *unintelligent being*. Neither truth nor falsehood is applicable to a *furd*, or *unintelligent nature*. Wherefore *eternal truth* infers the existence of an *immutable, intelligent, necessary Being*.—Now this argument, or demonstration, where the connection of ideas is as self-evident, as in any proposition in geometry, is not from any contingent being or effect. Hence there is nothing so certain, even *à priori*, as the existence of the Deity: because nothing could be certain, but from the certainty of an *immutable and eternal Mind*.

Truth



Truth otherwise would be without a foundation in nature. It must be owing to a good deal of inattention, not to see that all truths, even in geometry, on which we value ourselves so much, suppose this prior Truth, to prove them necessary and infallible. They cannot be eternal and immutable on any other principle. A *sceptic* in natural religion, or with respect to the existence of the Deity, is consistent enough with himself, when he is a sceptic in speculative science. — And if we argue fairly *à posteriori*, or from effects, the existence of the Deity, and his immediate operation in all nature, is demonstrable from every thing in the material universe. These arguments this author inadvertently endeavours to weaken, when he contends, *that effects may be greater than their cause*, as was shewn before.

X. I am justified to argue *à priori*, as I have done, from what this author himself writes elsewhere, when he says justly enough, “ Neither are they to be commended, who, under pretence of magnifying the essential power of the *supreme cause*, make truth and falsehood entirely to depend

“ pend upon his will ; as we observed of  
 “ *Des Cartes*, book 1. chap. 4. Such  
 “ tenets have a direct tendency to intro-  
 “ duce the absurd opinion, that intellectu-  
 “ al faculties may be so made, as clearly  
 “ and distinctly to perceive that to be true,  
 “ which is really false. They judge much  
 “ better, who, without scruple, measure  
 “ the Divine Omnipotence itself, and possi-  
 “ bility of things, by their own clear ideas  
 “ concerning them ; affirming that God  
 “ himself cannot make contradictions to be  
 “ true at the same time ; and represent the  
 “ certain part of our knowledge, in some  
 “ degree, as the knowledge and wisdom of  
 “ the Deity, imparted to us in the views  
 “ of nature, which he hath laid before  
 “ us (e).”——All demonstrative know-  
 ledge, *i. e.* truth, is here rightly carried  
 up to the Divine Intellect. It can have no  
 other foundation in the nature of things.  
 And tho’ perhaps this may not have been  
 attended to, by those who have made the  
 greatest discoveries in abstract science ; yet  
 the certainty of all they have demonstrated,  
 can only be deduced from the immutable  
 nature of the Deity. This is tacitly sup-

posed in every proposition in mathematicks. Men generally content themselves with seeing the necessary nature of truth ; but there is a farther question ; *What makes the nature of truth thus necessary ?* This puts us to a stand, and engages us to consider, that truth is not a thing existing by itself. Its necessity therefore must be owing to something existing by itself. This puts us again upon considering, that truth is only certain knowledge, and knowledge has a necessary relation to a knowing or intelligent Being. If we could suppose no *intelligent thing* existing, truth, or knowledge, would be an *eternal property without a subject* ; which is impossible, and repugnant : or otherwise *truth would cease*, be only a *chimæra*, and no way necessary. This puts us at last upon rectifying the supposition we made, of *no intelligent thing existing*. And thus the necessary nature of truth demonstrates to us a *necessary intelligent Being*.——Those who say, such reasoning is very metaphysical, may please to observe, that it is only common and self-evident principles, joined as they ought to be : and that all mathematics are as metaphysical ; only we are at  
more

more pains there to study the connection. The reason why the abstract sciences must be metaphysical, is, because in these, men abstract from all particulars, and consider only the general properties in which they all agree. This makes mathematics certain knowledge, and the demonstrations universal.——It is not like a mathematician to complain of metaphysical reasoning.——Of arguments *à priori* more hath been spoke elsewhere.

XI. As to the Cartesian notion, that *truth* and *falsehood* depend on the will of the Deity ; we might as well say, that his nature, or his necessary existence, depended on his will, as that his knowledge depends on his will. Knowledge is a perfection, and all his perfections are unchangeable, and absolutely the greatest. Greater perfection is a contradiction ; the perfection of no being, of nothing : that is, no perfection, or the negation of perfection. And to suppose him willing to change his perfection, is to suppose him inconsistent with himself. It is foolish therefore to suppose his knowledge depending on his will, since  
he

he could not will it to be other than what it is, without being inconsistent with himself, and his nature self-destructive. Truth is well worth enquiring after ; it is as necessary as the nature of the Deity ! We shall see the immortality of the *human soul*, its duration through endless ages, depending on this principle, even on the immutable nature of the Deity. Truth concludes to all futurity, and shews things to come as certain, as things past.

XII. Space is said, in the place cited above, to have a *necessary nature*. It is proper to understand in what sense space is necessary. This may help us to avoid the idle disputes that have been raised about it. *Space* is not more necessary than *duration*. Duration can only be limited by duration, just as space can only be limited by space : that is, both of them are necessarily unlimited. Duration cannot be interrupted, or taken away, more than space. We ought not then to be more puzzled about the nature of space, than about the nature of duration. Unlimited duration is the same thing as *eternity*, and unlimited space

K the

the same thing as immensity. But eternity and immensity are not beings, more than power and knowledge are beings. They are only the perfections of a Being who is immense and eternal; just as unlimited power and unlimited knowledge are the perfections of a Being, who is omnipotent and omniscient. We cannot therefore understand the necessity of space and duration aright, but by considering the necessity of that Being to whom they belong. They are necessary as the affections of Being; not as beings. As the properties of a contingent being, such as *solidity*, or *mobility*, are contingent, and can only be referred to the Being of which they are properties: so the properties of a necessary being must be necessary, and can only be referred to that necessary Being whose properties they are. But in our own minds, we imagine *space* and *duration* existing absolutely, and independently; that is, without relation to any being: which is just supposing them either to be beings, or to have a necessity of their own, and independent of all things. This is an inconsistency in our own minds, and not an unintelligibleness in the things.

It

It is as much against the rules of reasoning, to say *duration* exists necessarily, without a being whose duration is necessary; or *immensity* exists necessarily, without a being whose necessary existence is immense; as to say, *knowledge* exists without a knowing being; or *truth* without a mind; or *power* without any thing to be powerful. If I might speak so logically, all *abstracts* suppose their *concretes*, from which they are abstracted: and this is as true of eternity, of immensity, of knowledge, of power, of truth; as of solidity, or mobility, or hardness, or divisibility. In a word, *eternity* and *immensity* are not existences; but the perfections, properties, or attributes, of some being that exists.——And when it is said, *we have not that direct self-evidence for the necessary existence of the Deity, which we have for the necessary existence of space*; it is supposing these to be *two independent existences*, which we see with different degrees of evidence: and that at the same time too, that it is acknowledged, that the necessary existence of space is relative of the necessary existence of the Deity.——

This, as I said, is a wrong apology for Sir

*Isaac Newton's* notion of space ; and it perverts that notion. No man has a right to put off his own notions under the authority of another. If the one of these be relative of the other, we must see them both at once, and with the same evidence. It is a logical axiom, *of correlates* (or things relative of each other) *placing one, is placing the other*. What self-evidence have we for the necessary existence of space, or immensity, which we have not for the necessary existence of an immense Being ? No man ever saw space with his eyes, or heard it, or touched it. It is not an object of sense ; but a conclusion drawn from reason. And the necessary existence of an immense Being, is also a conclusion drawn from reason ; since a property or attribute, cannot be, or exist, without a subject. We see bodies *exist* in space ; but do we not see them also *exist* in time ? And do we not see them also *moved* by an invisible power ? that is, we see that bodies *are, move, and exist*, in something invisible ; and are constantly influenced by an invisible Being. If all our knowledge begins from sense, yet it is perfected from reason. And there is

no



no self-evidence for the necessary existence of space, which there is not for the necessary existence of the Deity; that is, of an eternal and immense Being: except we prefer the evidence of sense, to the evidence of reason. Which I am afraid is at the bottom of the author's notion in the place cited.—In fine, *immensity* and *eternity*, have the same inseparable relation to a necessary Being, that *time* and *place* have to contingent beings. Yet we would not say that *time* and *place* are existences. And as *time* and *place* are not existences, so their *correlate infinites* (if I may so say) that is, *eternity* and *immensity*, are not existences, but the properties of necessary existence.

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## S E C T. VI.

*That mechanism is not an effect of matter and motion, but the artful configuration and disposition of the parts of a dead substance ; that therefore it cannot act as a cause, nor carry on the works of nature, more than rude matter. Of mechanism in the performance of art, in the bodies of animals, in vegetables, in the works of insects. That mechanism in these cannot become a power, either to produce or increase motion. That in all cases it serves to supply a necessity, but never to act as a cause. That mechanical principles are only necessary consequences of the inactivity of matter, and cannot regulate power. That there is no mechanism in the other parts of nature. Of the folly of supposing the Deity to subordinate his own power to act for himself ; or of supposing him to convey the impressions of his power from place to place, by the help of dead matter, &c.*

**N**otwithstanding we have been often told  
by this author, in places cited above,  
I that

that we are frequently meeting with *powers* that *seem* to surpass mere mechanism, or the effects of matter and motion ; yet afterward he asserts, that *mechanism* acts as a second cause, in carrying on the works of nature. It is said, “ tho’ he [the Deity] is the source  
 “ of all efficacy, yet we find that place is  
 “ left for *second causes* to act in subordi-  
 “ nation to him ; and *mechanism* has its  
 “ share in carrying on the great scheme of  
 “ nature. The establishing the equality  
 “ of action and reaction, even in those  
 “ powers that *seem to surpass mechanism*,  
 “ and to be more immediately derived from  
 “ him, *seems* to be an indication, that those  
 “ powers, while they derive their efficacy  
 “ from him, are however in a certain de-  
 “ gree, circumscribed and regulated in their  
 “ operations, by mechanical principles ;  
 “ and that they are not to be considered as  
 “ mere immediate volitions of his (as they  
 “ are often represented) but rather as in-  
 “ struments made by him, to perform the  
 “ purposes for which he intended them.  
 “ If, for example, the most noble phænomena in nature be produced by a rare  
 “ elastic medium, as Sir Isaac Newton con-  
 K 4 jectured,

" jectured, the whole efficacy of this me-  
 " dium must be resolved into his power and  
 " will who is the *supreme cause*." (a) This  
 place is very exceptionable, tho' softened  
 with metaphorical expressions, and language  
 borrowed from another subject. If we  
 speak of *second causes acting in subordination to the Deity*, meaning angels or separate  
 spirits, or other free agents, in the moral  
 world ; the language is significant : but if  
 we apply such expressions to *matter* and *mo-*  
*tion*, they have quite another, and that a  
 very wrong meaning too, which the bringing  
 in the power or the Deity does not miti-  
 gate : it is rather prostituting the power of  
 the Deity, to support an absurdity. If I  
 should say, tho' the Deity be the source  
 of all efficacy, yet *matter has its share in*  
*carrying on the great scheme of nature* ; this  
 would make matter the second cause that  
 acts in subordination to the Deity, in carrying  
 on the *great scheme*. I should be very high-  
 ly to blame, for substituting an unactive sub-  
 stance to the Deity in carrying on the works  
 of nature : and yet these are but two ways  
 of expressing the same thing. I might be

(a) See Page 338.

shewn

shewn to invert reason, by making matter and motion (for we shall see that these are the things meant by *mechanical principles*;) circumscribe and regulate *powers*, which I own seem to surpass mechanism; and inconsistent with myself in objecting to *Des Cartes*, *Spinoza*, and *Leibnitz*, this absurd doctrine: and then going into it myself a little after: for all these owned the Deity to be the *supreme cause*, and source of all efficacy, and yet ascribed the government of the world to mechanism, and the powers of matter.

II. Tho' what has been already said in the former sections, be directly applicable to shew the absurdity of this assertion; when it was shewn, that all matter is equally an unactive substance, and that all those powers which were formerly supposed to belong to matter, are only the effects of immaterial power immediately impressed on matter: yet as mechanism is here said to have a share in the government of the material universe, it will be necessary to enquire a little, into the nature of mechanism, and mechanical principles.—When it is

is said above, that we are always meeting with powers, that seem to surpass *mere mechanism, or the effects of matter and motion*, this supposes that mechanism is the effect of matter and motion, which is a mighty wide step in the beginning, and supposes too much. Mechanism will be found to be quite another thing. But let us reflect on *matter* and *motion* themselves, which are supposed to produce mechanism, how far their bare existence engages the immediate action of the Deity.—Matter exists by the power of the Creator constantly put forth upon it, as is manifest by the strong cohesion between its parts. This, by the very terms, is not the action of other matter, nor mechanical; and yet it is the effect of a constant power, nor would it be from the purpose if I should observe, that they entertain a wrong notion, who imagine that matter, after its first creation, exists without any farther power of the Deity; or that it is a substance that would remain of itself for ever after. No created substance has a self-preserving power, or does not stand in need of any farther support. It hath been long and often observed, that

that the existence of any contingent being this minute, hath no connexion with, or influence upon its existence the next minute. There must be therefore a cause that determines its existence from minute to minute.—

We see a stone lying upon the ground, and imagine to ourselves, that it would remain there to eternity, by its own nature. This is wrong : we forget the constant impressions that are made upon it, both of gravitation, and cohesion.—Then as to *motion*, whence will a philosopher bring this impression ? It is an *impression*, for motion is not essential to matter. Matter at rest resists motion : therefore the impression must be from something immaterial. Motion is constantly decaying in the universe : therefore it must be constantly repaired by immaterial power. The *Cartesian* notion, that the same quantity of it is still kept up, by being communicated from one body to another, is against demonstration, and deservedly rejected above. *Spinoza's* notion is yet more desperately absurd, that one body is determined to motion or rest by another, and that by another, and that by yet

yet another ; and so on in infinitum. (b) Now when we see that the very existence of matter, and the constant repairing of motion, requires the constant influence and power of the Deity ; How can we imagine that *mechanism*, which is supposed here to be the effect of matter and motion, can carry on the great scheme of nature as a second cause, or in subordination to the Deity ? How ridiculous is it to say, that the Deity subordinates his own power to act for himself ! If we consider the place cited in this view, we shall see what an ambiguity of expression is used, to make this absurdity pass upon us.

(b) *Corpus motum, vel quiescens, ad motum, vel quietem determinari debuit ab alio corpore, quod etiam ad motum, vel quietem determinatum fuit ab alio, & illud iterum ab alio ; & sic in infinitum.* Lemma 3. Partis 2. Ethices. These are the words of a man resolved to affront reason in the most outrageous manner. And yet all those who ascribe *powers* to matter, affront it in the very same manner ; as was shewn, when we considered the *determining principle* in the two bits of cork, or the two loadstones.

### III. This



III. This is the philosophical notion of mechanism, that it is the effect of matter and motion; but, as I said, it is quite another thing. If we consider first that sort of mechanism which we are best acquainted with, we shall be the better able to understand the nature of it, where it is more complex. — Mechanism, in the works of art, is only parts of matter, differently formed, and skillfully set together in order to communicate motion (impressed by a living force) from one part to another. Here neither the forming the parts of a due figure and magnitude, nor the disposing them in their proper places, when formed, can be pretended to be the effects of matter and motion. And we need only turn our thoughts to any piece of clock-work, to be satisfied that this description is just, in the performances of art. The *power* (as it is called) must always be borrowed. These are sometimes called *engines* or *automata*, words which import, that such machines have a selfmoving power. These names, tho' they may pass in common

mon discourse, are yet improper in philosophical strictness, and tend to give us false notions. Take off the weight from a common clock, and see what becomes of the self-moving power then. It is this gravitation on a piece of lead that gives motion to the whole ; and the constant impression continues the motion : for the impression of gravity is as constant upon this piece of inactive matter when it lies upon the ground, as when it communicates that impression to the wheels of the machine. We might say with as much propriety that a hand-mill, or a wheel-barrow, was a self-moving engine : for these could move only as long as a power, or living force was applied to them, and no machine can move longer. It is great unskillfulness, or rather want of thought, to imagine that cutting iron, or brass, or any other materials into parts of certain figures, and then applying them to one another, could ever give the work made up of them a self-moving power. The effect then would be incomparably more perfect than its cause. Figure and shape would produce power. This must convince  
any

any reasonable man, that a *power*, or *living force*, must be constantly impressed *ab extra*, on all engines, in order to produce a continued motion in them. Every one will remember how many fruitless attempts have been made, by ignorant people, to find out a perpetual motion. The external power was always wanting, or the art to apply it. The necessity of a *power* is the same in all mechanism, as well in nature, as in the works of art ; because matter is equally *inert* in all cases.

IV. Now we have no notion of mechanism, but what we derive from the works of art ; where uncontroverted experience contradicts the assertion above : why then should we affirm in cases where we are not such judges, that *mechanism may, and does act as a cause* ? But, as I have already observed, when the absurdities are multiplied, and become innumerable, we take refuge in the confusion, to assert a thing which we see false in the simplest cases. When we reason concerning 3, 4, 5, or any particular number of particles of matter, we see it impossible that self-motion can be made  
out

out of these ; if we take as many more, the effect is equally impossible in these, as in the former. Let us continue thus to add parts of matter as far as we please, and we only increase the impossibility, by multiplying the inactivity and resistance of the parts to be moved. This, in few words, shews universally the absurdity of the thing asserted.—Now matter is unactive, and resists a change of state as much, in the bodies of animals, in vegetables, and in all the parts of nature, even in the *subtile matters* of the philosophers (if there were such things) as in a clock, or a watch.

V. In the works of nature, mechanism is chiefly remarkable in the bodies of animals. In forming the parts there, and ranging them in order, the art is really inconceivably fine and various : but in such soft and yielding materials, the *motive power* must be applied much more variously, both to continue the many different motions that are constant in the several parts of the body, as the *heart, stomach, lungs, intestines*; and to renew those motions that are interrupted, and restored by turns, while we *walk, work, or speak*.

*Speak.* This, if we take time to consider it, is indeed astonishing ! when a man pronounces a discourse, or plays a tune on an instrument, does matter (a dead substance) *determine itself* so variously ! *turn, stop, begin again*, so quickly ! I should think, we need only consider the inactivity of matter on the one hand, and the life and action in this appearance, on the other, to determine this point, against all the authority of philosophers. In machines of human contrivance, it is but one single power that acts, or two at most : we know not the *application* of more : but in the mechanism of an animal body, an inconceivable number of powers act ; or, to speak more truly, it is the *same power* that acts in many different places at once, and with inexpressible variety.——It has often been demonstrated, that in the action of soft bodies upon soft bodies, the motion is always diminished. How much then, and how constantly must it be diminished, in the yielding softness of the *flesh* and *fluids* of animal bodies ! Let us reflect how soon water settles, after motion impressed, by the bare *attrition* of its parts on one another ; altho' it has no

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obstacles

obstacles to encounter, or narrow passages to move through. Motion is easily continued, or communicated, in free spaces, especially if the moving body be hard and firm : but it is quite otherwise in the *veins, arteries, intestines, and lacteal vessels* of the bodies of animals ; in the narrow twining meanders, which convey the fluids constantly to parts really innumerable. The capacity of these slender tubes could not admit the finest hair ; and the mazes and windings are to us inconceivably perplexed and intricate. What a quantity of *attrition* must there be, while the *blood, lymph, and chyle* move, or rather (if I might so express it) creep through these ? No mathematician hath yet been able to calculate the attrition of the parts of fluids upon one another, while they move, or against the sides of such narrow vessels, or the loss of motion in the constant change of direction : but we may safely say in this case, that the whole motion is consumed every instant, and the force renewed every instant. A *strong power* therefore urges on the fluids in the animal bodies ten thousand different ways at once. Philosophers

phers have not yet found out a *term of art* to account for this *power*. It acts upward, against the nature of gravity. Attraction between the particles of fluids does not help us out. Attraction to all sides would rather stop motion ; as it does between the particles of liquors. The alternate contraction and dilatation of the coats of the vessels, is a postulate which supposes the thing to be explained mechanically ; and it is no where applicable, but to the heart and arteries. It is an attempt as full of ignorance as vanity, to offer to account mechanically for the *circulation* in the animal body.—Thus we have a miraculous *power* indefinitely and variously put forth in our own bodies. It is the tremendous power of our Creator. We are not only fearfully and wonderfully formed in the womb, but fearfully and wonderfully preserved every minute ! Creating power never ceases.—Is this mechanism the work of matter and motion ? The motion is constantly consumed, and new force constantly impressed. The mechanical structure is wonderfully formed at first, and as wonderfully preserved ever after.

VI. Why then (it will be said) was such an intricate structure of such materials employed, or such a laborious method contrived, by the organization of dead matter; if it no way serves to produce motion, but rather consumes the force impressed?—— Tho' we could not assign the reason for this, it is still manifest, that dead matter, however divided, or compounded, cannot produce motion, or supply the place of a moving power. This question itself arises rather from our prejudice, and inattention, in supposing that the organization of a dead substance should produce motion, or give that substance a *self-motive power*. That this mechanism consumes the force impressed, is no inconvenience in nature, if we consider who renews it. We are forced to be frugal of the little power we can command. This is not applicable to the Deity.——But dead matter was to become a *dwelling* (if I may so say) to a living substance. It was to convey sensation to a percipient being in a state of union, that is, in a state of confinement; and to be actuated by such a being as had but a small, a very small



small degree of motive power. The power of the Almighty was to supply that defect. This was the wonderful *problem* which was to be performed, that there might be beings made up of matter and spirit, to continue the scale of the creation, and raise it from dead matter to living substance. This was to be the *transition* from the one to the other. Matter was before raised through all the degrees of vegetation, till it bordered upon sense : and even there, the power of the Almighty is constantly employed. Vegetation is as little a *second cause* as mechanism. The next step was to unite two substances of opposite natures together : and the power was to be supplied, as long as the union was to continue. And this *problem* was to be wrought in a different manner, in every different species of living creatures, and repeated in every individual of every species. So little is the *governing power* of the Deity different from, or inferior to, his *creating power* ; as shall be shewn afterwards.—And all this various work was to instruct rational beings, by displaying to them the goodness, wisdom, and power of their Creator, constantly put

forth for the advancement of their rational nature. No other design can be named. *Infinite goodness* is a powerful motive ; and from this motive infinite wisdom always acts.—Thus we see that the organization of a dead substance is never employed, but for the wisest and best reasons. The very word implies that the substance is to be subservient to sensation, and spontaneous motion. This is the great end of mechanism in the animal body : and the mechanism in vegetables is subservient to the necessities of animal life. There was no reason why such work should have been employed in the other parts of the creation. We mistake the nature of mechanism altogether, when we suppose it designed to produce, or increase motion. This is a prejudice we should endeavour to get the better of.—But to return,

VII. The vital parts of the animal body, if I may so speak, consisting of such soft and pliable materials, were to be supported by something of a firmer texture. They were to be fixt to, or inserted in bones, which might keep them in their order,

order, and from falling upon one another : and at the same time, those more pliable parts were to draw the bones to which they are affixed, in different directions, and to form different angles with each other, just as the ropes draw the beams to which the weight, to be raised, is affixed. One continued compages, or frame, of stiff, rigid bones, firmly indented into one another, could not have yielded to the various motions, necessary to the several wants of the living creature. Life without motion had been a misery to the animal, and a visible want of contrivance. The bones therefore were to be joined moveably, by different methods ; the joinings were to be loose, and yet strong. The *Greeks* have given names to these different methods of joining ; and human industry has endeavoured to imitate them, for the conveniencies of motion. — Now it is obvious, from this general view of the structure, that it is fitted only to facilitate the exercise of motion ; but not at all either to produce, or increase motion, more than the simplest machines that we know. And that it is more complicated, is, because it answers a far greater variety

of motions ; therefore it requires infinitely more art, in forming the parts, and such a variety in the application of the power, as amazes us. How many different motions are there in the *hand* alone, which can be exercised separately, or all together ? It was to be the universal instrument. How many different modifications, and directions can we give to the motion of the leg, or arm ! The several advantages of these we hardly ever reflect upon, till accident, or age deprives us of them. Certainly we lose a great deal of rational pleasure, in not attending to the goodness of our Creator, who continually supplies the *power*, and whose wisdom contrived the art. Our wants are prevented before we feel them. From this it appears, that it is the reverse of right reasoning, to imagine, that such a complicated machine may become a *power* to itself. It is to suppose, that the greater the want of a *power* is, the less the necessity is for it.

VIII. It hath been observed elsewhere, that the *Creator* is the first *optician*, the first *geometer*, the first in every part of know-

knowledge ; or rather these expressions still diminish the truth : and certainly the animal body shews him *the first, the great mechanic*. It is an injury done to truth, to compare the performances of human art with the works of nature. The bones of animals are the original, and most effectual *levers*. The tendons are the *chords*. The *power* is miraculously applied to the muscles themselves, the softest, weakest parts of all ! What created being can imitate this ! Their longitudinal and transverse fibres fit them to be contracted in length and breadth alternately, as necessity requires. They are contracted after extension, the same way, and by the same power, that a musical chord is contracted after straining ; that is, by attraction between their parts, which is no power in matter, nor inherent in these parts. An external force performs both the extension and contraction. In an earth-worm both these motions are spontaneous ; as also in antagonist muscles. Spontaneity is no property of matter. It is wrong in anatomists to say, that *contraction* is the natural state of the muscular fibres of the heart, and coats of the arteries, and all other

other vessels ; or that they only require external force to extend them, but contract themselves again by a power inherent in their parts. This would be a self-moving power, after they are once in a state of rest ; which is inconsistent with the resistance of the parts of matter to change their state. Let us consider how strongly contraction is increased between the parts of a rope, or cord, by only wetting them. This force is not exerted by the particles of water, or the fibres of the hemp. Such a rope by its contraction, will raise a prodigious weight, many hundred times greater, than the *inertia* of these parts : and this *inertia* is the only property belonging to a dead substance, and inconsistent with any active power in it. How strongly does a hair contract itself, when stretched till it breaks ? The coats of these vessels, when thoroughly dried, do not contract themselves. Contraction then cannot be their natural state, nor inherent in their parts. If I might mention a low experiment, how severely does a tight shoe, when wet, pinch the foot, by the contraction of its parts ? The attraction of cohesion is thus increased to a great degree. In short,

short, no kind of attraction belongs to matter.——Thus we see that immaterial power is doubly exerted in every the least spontaneous motion, both in the extension and contraction of the muscular fibres. No sort of fluid seems to be concerned in the contraction and extension of the muscles, or in their swelling and subsiding; if the *electrical fire* be the animal spirits, as is hinted in a place above.——One particular here claims our utmost admiration, that, tho' spontaneous and involuntary motions are exercised in the same parts (the same muscles and fibres) of the animal body; yet the stopping and renewing the one, does not hinder or disturb the other! We begin, change, and modify the motions that depend upon the will, innumerable ways, while the other motions continue regular. Of how much goodness and wisdom is this contrivance! and by what wonderful power is it performed! What inconveniences would not have followed, if we had been forced to give constant attendance to the respiration alone, not to speak of other motions? This was not impossible to infinite power; it is in some degree subjected to the

the will already, when we have a mind to use that power. Sleep in that case had been impossible : or to sleep and to dye had been the same thing. It is a common expression to say, *the Lord watcheth over us* : but do we understand, how literally this is true ? Our Creator does more than *watch*, both while we sleep, and while we are awake. How absurd is it to speak of *mechanism* as a thing that sets the care of the Deity aside ; or that carries on the course of nature ! *Des Cartes's* philosophy, who made animals mere machines, served only to debauch his reason, and to make him blind to truth. Shall I be forgiven, when I say, philosophers of all men, ought to be most upon their guard, lest study debauch their understanding. There is a sort of learning, which is much more hurtful than ignorance. It is on this account that so many philosophers have been branded by *Mr. Bayle*, with the imputation of atheism, which is the most shameful ignorance, even in their own profession.

IX. The expedients to facilitate spontaneous motion in the several species of living creatures,



creatures, are wonderful. But where most mechanism is necessary, or employed, the motion there is most difficult to be performed. This is directly contrary to the notion, that mechanism produces motion, or becomes a power. To creatures that move in air or water, motion is easy; but to reptiles that crawl on a hard, rugged surface, to transport their bodies, tho' little, from one place to another, is extremely laborious. It is both instructive and pleasant to see the caterpillar, that has a multitude of short legs on each side, creep along. As the legs opposite to one another, move forward successively, there appears an undulation, as it were, in the long body of the creature, as if it moved by parts. Thirty or forty different steps are made, to get one short step forward. What a multitude of machinery is here, to make progressive motion practicable to this species; and how much easier is it performed by creatures which have but two legs, or four! there is not such a various and fine mechanism, in the whale or elephant, as in this poor insect.

—If mechanism became a *power*, or *agent*, to carry on the works of nature, a com-

complicated machinery would make the power greater, and more effectual: this is contrary to experience. Where the mechanism must be multiplied, the motive power becomes less. The friction, and action of the parts on each other, consumes the force impressed. The power must therefore be increased, or the machine goes heavily. Artists know this well, who have but a given quantity of force to employ. When one wheel is moved by another, and that by another, and that by still another; as it is in some complicated engines, the motive force always becomes weak, as the *inertia* of the matter, and attrition of the parts, is increased. The *inertia* of the matter is always proportional to the quantity of it, as was shewn in sect. 1; and the attrition of the parts is still greater, in proportion to the force employed, or matter to be moved.—All complicated machinery is soonest disordered. How is this consistent with mechanism becoming a power? If philosophers would reflect on common objects, they would reason better, and insist less on the *efficacy* of mechanical principles, and mechanism, in carrying

rying on the great work of nature.——As was observed above, to say, *mechanism does this in subordination to the Deity*, is only bringing in omnipotence to help out an absurdity ; namely, that matter, which necessarily resists all change of its state, should, by the configuration and disposition of its parts, become self-moving. Omnipotence is no refuge for a contradiction. And to have recourse to it, in opposition to plain reason, is a bad sign of any hypothesis. People think they cannot talk absurdly, if they name the Deity : tho' it was allowed before, that to perform a contradiction, is no object of infinite power. This is not to be consistent with ones self, more than to assert the *inertia* of matter in one place, and the efficacy of mechanism in another. To talk rationally is to talk piously. Reason will never carry us to impiety, more than to absurdity.

X. It was shewn in the first part of the Enquiry, that even spontaneous motion is performed by the same power, as those motions, which depend not upon the will, are. This is indeed wonderful ; but it is true,

true. Any one who considers the case, or what is there said, must readily own it. Here the spontaneous being itself is admitted to a participation in producing the effect. This is the first step of the gradation above matter, in the rising scale ; and the lowest power of immaterial being united to organized matter. Every thing that has life partakes of this power ; but it advances by gentle degrees in ascending through the inferior species, till it comes to man, who is dignified with a higher power.—The motion is spontaneous, as it is begun and ended by the living being itself, without physical necessity, or as matter impells matter. As it is performed mechanically, above the power and knowledge of the spontaneous being, the motive power is immediately impressed by the Creator, who is the *only* mover, as well as the *first mover*. The distinction of being the *first mover* is improperly brought in, as if matter were a *second mover*. Of all this we may be certain, for (as was said just now concerning respiration) the muscles of the thorax are contracted and dilated the same way, and by the same power, in consequence of volition,

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as without the command of the will. Every man may make this experiment, by accelerating respiration, or stopping it for a little. We have the command of this motion to a certain degree ; but do nothing more when we accelerate it, (the bare act of the will excepted) than when it is performed against our will, after a short interval, or without the act of the will, while we sleep. Spontaneous motion therefore is performed by the same power, as those that are purely mechanical. (c)

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(c) In spontaneous motion, the spontaneous being itself hath only the power of directing the motive force to this or the other part of the body, by an act of the will, and of stopping it again. It cannot be pretended that this *direction*, or *stopping*, is mechanical, or that it is motion communicated from matter to matter, except it were supposed that the spontaneous being itself were material. And to suppose matter to have spontaneity, would be the same thing as supposing it to cease to be matter, or an unactive substance. This shews that every living creature hath an immaterial substance in it. The same substance cannot be both necessarily unactive, and yet active.—We know not how spirit, or immaterial substance, acts on matter, or matter on immaterial substance; but, by the terms, neither spirit moves matter, nor doth matter affect spirit mechanically. Hence *Des Cartes's* notion, that brute animals are only machines, is

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quite

—This is an adorable condescension of the Creator, who exerts his power in consequence of the spontaneity of living creatures. Our prejudices only can make us think that this is low work for the supreme

quite unphilosophical. *Spinoza* improved the absurdity, by applying it to the souls of men. Even *Buridanus's* ass, between the two bundles of hay, was a wrong comparison to argue from. This man shewed the extravagance of *liberty*, by contending for *necessity*, without motive or reason. Much unintelligible subtilty hath been employed since, in contending that the soul of man was determined to act by a sort of invisible mechanism: but the author forgot to extend the *pre-established harmony* to brutes. Yet he owned to his friends, that this extraordinary notion was only a *lusus ingenii* (un jeu d'esprit) to try his parts, and laugh at the credulity of philosophers, who are as fond of a new paradox, as *enthusiasts* of a new light. This mortified those who had greedily swallowed the new improvement. And some of them, rather than appear the dupes of an ironical wit, pretended still to believe it, after the author had laugh'd at them. See *Maizeaux's Recueil de diverses pieces*, &c. If at other times he was so pleased with his own notions, in the *Theodicea*, as to defend them seriously against the learned doctor *Clarke*; that shewed only, that he angled for two different sorts of reputation, from the same performance; and unluckily he lost both. The subject was too serious to pass for a romance, and the principles too absurd to be admitted for truth.

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Lord of heaven and earth : but the cohesion of all the parts of matter, in the bodies of those very living creatures, and through all the material world, should silence this general prejudice. We forget what infinite power implies, and what infinite goodness prompts. We apply our own narrow notions, and unperforming haughtiness, to these perfections. Difficulty ceases before infinite power, and lowness of work is quite unapplicable to the Creator of all things. He is as much the Creator of the meanest insect, as of the highest *intelligence*. We need not be afraid of spoiling our philosophy, by admitting this power. To follow reason can never hurt philosophy, nor *put an end to our enquiries in the most sublime parts of it*. That complaint seems rather to be made, because men have not still a liberty of hunting for *power in subtile matters*.

XI. There is besides a mechanism in vegetables. Every plant, flower or herb, has its particular mechanical structure, as the microscope informs us. This is a theme of wonder for higher beings than

man. It is but to look at what our eyes, thus assisted, inform us of, to be ravish'd with admiration. But this mechanism is neither designed to produce, nor increase motion, nor to *act as a cause* in any sense. The Creator could do every thing by an instantaneous act of power, but he uses a slow process, and an established course of nature, for the instruction of rational beings. The contrivance in an effect produced all at once, is not preceptible. We are thus taught to admire his wisdom, as well as his power. He is not obliged to use mechanism as a help in the formation either of animals or vegetables now, more than in the first creation of things. To imagine mechanism necessary in the formation of man, or beast, or plant, is to suppose the successions of them eternal, and without beginning. And then it is to suppose, that matter can work up itself with such variety of art, and such regularity in every various species of things. And if the nature of matter made that impossible then, the same inactive nature makes it impossible still in every new production. Or, which is the same thing, the same acts of power must be repeated, and



and the same wisdom must contrive, in the formation of every individual of every species, at this day, as in the formation of the individuals at first. Matter never loses its resisting nature, nor becomes more docile.

——The mechanism in vegetables (as was observed above) is subservient to the animal life, and is a consequence of that design ; as the mechanism of the animal body is consequent of the design of uniting together two substances of opposite natures. This structure of parts is fitted to strain the various particles of flowers, fruits, seeds, &c. It only admits, or percolates, particles of different figures and sizes, the composition of which makes the specific seeds and fruits, but is it less artful because it is concealed from us ? The power is here effectually, and variously applied by the Creator, to carry these parts through so many obstacles, from cell to cell, and vessel to vessel: for the structure of parts in a plant, is as unperforming as the structure of parts in an honey-comb. And it exceeds our wonder that out of the same common moisture of the earth, such a variety of herbs, roots, fruits, flowers, &c. should be formed. A variety so great

that no man on earth can reckon up the several kinds, and each differing from the rest in taste, colour, smell, and many other properties. And by the same powerful art, the flesh of the various species of animals, differing in all these sensible qualities, is formed by the separation of parts of the same common food. We do not allow that out of the same materials of wood, iron, brass, so many things could be formed, for the conveniency of life, without art to govern, and power to perform.

XII. To what cause then will a philosopher ascribe this amazing variety of productions, and of workmanship out of the same common substance? All flesh, it is said, is but grass. It is indeed literally so, only manufactured (if we may so say) in a different manner. And all grass is manufactured out of the same common mass of rude earth. Can this be done without knowledge, and without power? What *subtile matter* shall we devise, or what name shall we invent, to amuse a diligent enquirer, and keep up the credit of philosophy? It is easy to get over absurdities, by taking

many together, and saying, *mechanism acts as a second cause*, and performs all these wonders : but the possibility of this would not be allowed, in the meanest performance of human art. We have another way of avoiding the trouble of a fair examination, by saying, *these are the works of nature* : and thus we are satisfied. But that expression imposes on our inattention, and gives us the bare sound of a word, for a powerful cause. *Nature* is only the method, or course of action, and not the *cause* that acts ; and whatever we ascribe to *nature*, is the immediate action of the *Author of nature*. It is therefore the Creator, *every where present, and every where active*, who cloaths the fields with green, and raises the trees of the forest ; who brings up the lowing herds, and bleating flocks ; who trims the fishes of the sea, and wings the inhabitants of the air ; the meanest insect, and reptile of the earth is his handy-work. He forms their bodies by art divine, and furnishes them with *instincts* yet more wonderful. This is good philosophy, when tried by the severest rules of reason.—The mechanism is various, not only in the dif-

ferent *species*, but in the different parts of the same *individual*. This is obvious in the animal body, and it is no less certain in vegetables. We cannot satisfy our curiosity, nor express our amazement, at the fine regular texture in one part of a plant, and at a different artifice, equally regular, in another part of it. Now the *mechanism* in one part could not work up a different artifice in another part. Parts set in order, could not set other parts in a different order. They remain in their place, till moved by some external force. A structure of parts can be no efficient cause, more than a heap of stones could build, or a multitude of types could print a book. Living force, and intelligent direction is wanting. What is order in one sort of structure, is confusion in another. This is the nature of mechanism, or of differently figured parts, set in a certain order. They are as inert, as a heap of particles lying in confusion. The mechanism therefore of the wood is no efficient cause of the different structure of parts, in the leaves, or fruit, or seed, or stone, or kernel. Power must be applied, and knowledge must direct every where.

XIII. It will not perhaps be amiss, in the last place, only to mention another sort of mechanism, which is the work of several living creatures; the cells wrought by the bee, to reposit its provisions in; the artful web of the spider, to entangle its prey; the delicate spinning of the silk-worm, to propagate the species, by its own death; the architecture of the swallow, and of all kinds of birds, in building their nests, to receive their future families. (d) Matter thus fashioned shews us both the nature, and the true design of mechanism. Art must be employed, and living force applied, to overcome the sluggishness of the substance, and dis-

(d) The *subtile jack*, as the *English* sailors call it, is a surprizing instance of this mechanical industry. They hang their nests from the extended branches of large trees, by cords made of a tough grass, fifteen or twenty foot down, and as far from the ground, that their young may be safe from the apes, which use to prey upon them. If the trees stand at a distance from others, they thus hang their nests quite round: but if a tree is near other trees, they hang their nests only from the farther side of it; and leave but a small hole of a convenient size, in the side of the nest, to go out and in at: and thus suspended in the air, they are guarded from their enemies. See *Dampier's* voyages.

pose

pose it in such a manner as to answer the purpose. It relieves the necessities of these creatures, just as the mechanism of *weaving*, or *building*, supplies the wants of men. This is the design of all mechanism; it supplies a necessity, and there its use ends: but it never *acts as a cause*. In the instances just now named, an external force is impressed upon matter, and the art is supplied by the immediate direction and guidance of the Creator, as hath been shewn in another place. This is the only source of instinct. And if these little animals must be guided in their mechanical performances, by a superior power and knowledge, can unguided matter work up a much finer texture in the leaf of a rose or tulip, nay in every blade of grass?—To have done; every thing in nature teaches us to admire *mechanism* as the effect of art: but not to admire art as the effect of mechanism. That would be the order of things inverted. The fineness of the work points out only the exquisite contrivance, and delicacy in performing. Is not the contrivance as deep, and the performance as geometrical; if we refer them to the immediate power of the Deity,

Deity, as if we refer'd them to matter and *mechanical principles*? Would we have our geometry a thing independent on the Deity? Or would our philosophy be the better, the less we ascribed to his immediate efficiency, and the more we ascribed to matter? Who sees not that this is the fundamental mistake harboured in the mind? A system is reckoned perfect only, as it pretends to explain all appearances, by matter and mechanical principles. The attempt is vain. The inactivity of matter is now established (tho' some would fain call it in doubt again;) and this plain truth hath opened the eyes of the world. Our philosophy can only be consistent, when we take in the immediate power of the Creator, as the *efficient cause* in all the works of nature. The *great scheme of nature* is freed from contradictions, and appears harmonious, when *mechanism* has no share in carrying it on. The effects always require an infinite wise and powerful cause; and such a cause is equal to the various and wonderful effects. But low and pitiful are the shifts we are put to, when we would remove the Deity to the head of nature, and the head of nature out of sight.

While

While we would make our philosophy the admiration of ignorant people, it only becomes unintelligible to ourselves. No man had ever a notion, how mechanism could carry on the scheme of nature.

XIV. As to *mechanical principles*, they are often mentioned, and always with an emphasis, as if they had a secret virtue in them, which will disappear when they are considered. In the place cited it is said, powers which *seem* to surpass mechanism, are in a certain degree circumscribed, and regulated by *mechanical principles*. A reason for this, or an example of it, would have made the absurdity of the assertion too plain. As was observed before, this is reason taken backward ; because it would have been more reasonable to say, powers which surpass mechanism, regulate the operations in mechanism ; than that the principles of mechanism regulate powers which surpass mechanism. These principles are the three laws of motion in Sir *Isaac Newton's* philosophy, mentioned in the first section of these papers : namely, that a body perseveres in a state of rest, or moving uniformly for-



forward, till a change of state is wrought in it by some external cause. This is a consequence of the inactivity of matter. Secondly, that this change of state is always proportional to the force impressed, and in the same direction in which it is impressed. This is equally a consequence of the inactivity of matter. And lastly, that action is always contrary and equal to reaction: or the action of two bodies on each other is equal, and directed to contrary parts. This is likewise a necessary consequence of the inactivity of matter. And here by the way, we may observe, how absurd it is, to apply this third law of motion to the impression of immaterial power! I am sure Sir *Isaac Newton* never understood it in this sense. It is plainly meant of the action of two bodies. It was remarked lately, when speaking of the power which spontaneous beings have to begin, and stop motion in the body, that the way how immaterial beings affect matter, or matter immaterial beings, is above the laws of mechanical motion. The impression of power then is above the principles of mechanism; except we would suppose all beings material,

and that matter has *power* to begin and stop motion.——These three laws are the only *mechanical principles*. And we thus see that they (and therefore all the theorems deduced from them) are the necessary consequences of the *inertia* of matter. And on the other hand we saw in all sorts of mechanism, considered above, that the *motive power* is impressed immediately by the Deity. Now what will this amount to? It is really no less than to say, the inactivity of matter in a certain degree, circumscribes and regulates the power of the Deity. All that matter does, is by its inactivity, or the resistance it makes to change its state: but the Deity commands the inactivity of matter. Would we have matter to make no resistance to a change of its state? That would be to suppose it not to be matter. Even that would not make it active, as we saw in the first section above, where the author supposes that the resistance of bodies to change their state, may not be proportional to the quantity of solid matter in them. Matter by its resistance consumes the force impressed. This does not circumscribe or regulate the power. Matter does

does not consume the power that impressed the force, nor regulate it in any manner. Matter by its resistance changes the direction of the motion or force impressed : but this is *design*, the very art in disposing the parts of matter, to make its inactivity of use. Matter does not on this account regulate the art or the power ; but the power and art regulate the inactivity of matter.— Nothing was ever more unguarded than to say, mechanical principles circumscribe and regulate powers that surpass mechanism.

XV. There is no mechanism in the other parts of nature, where no organized system of unactive matter was to be united to a living being ; where the feebleness of no animal was to be assisted, in its spontaneous motions ; nor food to be provided for animals by vegetation : tho' it is there chiefly that the author seems to suppose mechanism to carry on the scheme of nature, as will appear below. Machinery in the other parts of nature would have been without a reason, and answered no purpose. We cannot suppose the Deity moving one part of matter, that it may convey  
the

the motion, and power, to another part at a distance, and that to another still more distant part; and so on. This is a prejudice; contracted by reasoning from our own infirmity and weakness, who are confined to one place. There is no parity in reasoning from the limitation of our nature, to Omnipotence. The Deity is present every where, and needs not convey his power from one place where he is present, to another place where he is equally present. The very supposition of *subtile matters*, that may convey the impressions of infinite power from place to place, is an absurdity in itself. This is as childish a fancy (bating the lowness of the comparison) as if a man should employ his left-hand, to take a thing from his right-hand, and carry it to his mouth. Impotence in the right-hand, could only justify this supposition. The practice otherwise would be absurd: and the matter employed to convey the motion, could not do it so effectually, as the immediate impression. To have right conceptions of the perfections of the Deity (which are all infinite) is certainly *the most sublime part of philosophy*, and the

the best exercise of our rational faculties. And to allow that, *he is every where present, and every where active*; and yet to suppose that *subtile matters* convey the impressions of his power from place to place, or that *mechanical principles* circumscribe it, is to set one part of our philosophy at variance with another; or it is to acknowledge his being every where active and present, only to satisfy a form.——I shall not again mention the cohesion of the parts of matter itself, which will occur to every man's thoughts in this case.

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## S E C T. VII.

*That power is not to be ascribed to that which resists the power. Power and instrument are opposite things. Action and reaction not applicable to the impression of immaterial power on matter, but to the resistance bodies make to each other. That the material universe was not formed by one sort of power, and is governed by an inferior power ; or that it is not governed by matter and mechanism. It is shewn, by an enumeration of particulars, that the material world is governed by a constant repetition of the acts of that same power, by which it was at first formed. The absurdity of saying the Creator governs the material universe by instruments and second causes. That matter cannot be an instrument to the Deity. These notions taken from human infirmities.*

**T**HERE are no other *second causes* named in the place cited, that act in subordination to the Deity, in the government of the material world, except mechanism,

chanism, or the configuration and disposition of the parts of dead matter, of which we have already spoke. But as more such causes are meant, since mechanism is only given as an example, it had been proper to have named them, and what share they had in carrying on the *great scheme*. This would have made the place more intelligible. To affirm a point of such importance in general, leaves a reader in the dark. In the moral world *second causes* are free agents. In the material world what are they ; free, or necessary ? This expression, so far as I can see, only imposes on us by the familiarity of the words. Second causes, if free, must be *living beings* ; and if necessary, they are not causes. *Necessary causes and passive powers*, affirm and deny the same thing at the same time : or they are concise contradictions.—Powers are likewise mentioned, as acting under the regulation of mechanical principles ; but we are not told what they are. The word *powers* is brought in on all occasions, as if the found were enough to satisfy us. It was observed before, that to ascribe, a *power* of attracting, a *power* of repelling, a *power* of cohesion,

of refraction, of reflection, &c. to matter, is the same thing, as accounting for the phænomena in nature, by occult qualities : for every appearance might be accounted for this way. All these were shewn to be the immediate effects of immaterial power, impressed by the Deity. That *powers* should be made *instruments*, as is said, is not easy to be understood. It is ridiculous to say the Deity employs his own power as an instrument ; and yet this is the least absurd sense that can be put upon these words. *Instrument* and *power* are opposites. The *instrument* is the thing used ; the power uses this instrument. The power is always applied from without, by something not matter. To say therefore that powers are made instruments, confounds two things essentially different. It is not so in physical disquisitions, as in moral subjects, where one man may be said to use another as an instrument. Man is a living being ; but matter is a dead substance. There should be a propriety of language in philosophical enquiries. In mechanics, where that word is often used, the difference between the *power* that moves, and the thing that is moved



moved (or *weight* that resists the power) is so essential, that if we take it away, we take away the very foundation of the science. If we suppose that the power which moves, may be the same with the thing that resists the motion ; we confound all truth, as well as mechanics. A thing cannot *move*, and *resist* that motion at once, more than it can do an action, and not do the same action at the same time. It was necessary to be thus particular on the abuse of this word, *power*.

H. When it is said, *the establishing the equality of action and reaction, even in those powers which seem to surpass mechanism — seems to be an indication, &c.* it is extremely wrong. It applies Sir Isaac Newton's third law of motion (which only relates to the action of one body on another) to the impression of immaterial power on matter. The equality of *action* and *reaction* is a consequence of the inactivity of matter, as I have shewn, and not above the laws of mechanism. Mechanism consists only in the artful configuration and disposition of the parts of matter. The impression of the *power*

is quite another thing, and independent of any figure or situation of parts. It overcomes the resistance of matter, and cannot therefore be a consequence of that resistance. If two men should push two bodies towards each other, with equal forces, so that the bodies should move with velocities inversely as their quantities of matter ; this is not action and reaction between the bodies, which are yet at a distance, but two different actions, that have no communication one with the other. There is no action and reaction, till the bodies meet. And if immaterial power urges two planets, or other bodies, towards each other, so that their velocities are inversely as their quantities of matter ; this is neither action and reaction between the distant bodies themselves, nor between the immaterial power and either of them. The author unwarily advances a thing which leads to *Spinoza's* impious absurdity, that matter, or body, belonged to the nature of the Deity (a). And yet the *establishing the equality*

(a) This atheistical writer says, *per corpus intelligo modum, qui Dei essentiam, quatenus ut res extensa consideratur,*

*equality of action and reaction*, cannot be meant of the action and reaction between two bodies. That would be the same as if we should call that, *The establishing a thing*, which is impossible to be otherwise. We cannot conceive action between the parts of matter, without equal reaction, or resistance. If the action were greater than the resistance, the excess of that action would be against nothing; that is, it would not be action, which is a contradiction. A thing necessary is above being established. We do not say, *the establishing the equality between twice two and four*. This author had shewn before, that truth is not arbitrary, nor depending upon the will of the Deity.——When he says, that *powers are not to be considered as mere immediate volitions of the Deity (as they are often represented) but rather as instruments made by*

*deratur, certo modo exprimit*. Definit. 1. part. 2. Ethics. And refers to what he says more generally elsewhere. *Res particulares nihil sunt, nisi Dei attributorum affectiones, sive modi, quibus Dei attributa certo & determinato modo exprimuntur*. Coroll. prop. 25. part. 1. Eth. And to say, action and reaction are equal between the impression of divine power and matter, leads directly to to materialism.

him, &c. he seems not to have considered how they were represented. No body who understands what he says, ever represented *power* as mere volition. It is indeed often, and always represented, that *all power* in the material world is the immediate impression of the Deity, and neither *mere volitions*, nor yet *instruments made by him* : and the reason is, because matter has no sort of power, but a stubborn inactivity. The Deity does not *will* an effect, without exerting the power to produce it. The one is as easy to him as the other ; tho' we often *will*, without having the power to perform. And it is no loss to rational beings, or a disadvantage in any respect, that the Deity, who can be *excluded* from no place, but is *active and present every where*, should act immediately on all the parts of matter. If no reason can be given against this, and if the reasons for it are not objected to ; it must be a great love to matter and motion, still to pretend that mechanism has its share in carrying on the *great scheme*.——But when it is said, that those who affirm, that the Deity acts immediately on all the parts of matter, represent his action on matter as *mere volition* ;

*volition*; is not this to insinuate, that the Deity cannot act immediately on matter, without *second causes*, or *instruments*? Because this could not be *action*, but only *mere volition*. Then matter only could act on matter. I leave it to the reader's determination.

III. When it is said, if a *rare elastic medium* produces the most noble phænomena in nature, as Sir *Isaac Newton* conjectured, the whole efficacy of this medium must be resolved into his power and will, who is the supreme cause. This is only admitting the power of the Deity conditionally, which is no great compliment to him. Matter is still the immediate *efficient* of the most noble phænomena in nature, and He only a *remote cause*. This is not right. We confine the action of the Deity to our hypothesis.—But what if this *medium* should be without foundation? What are we to do then; or where shall the efficiency of the Deity appear? Must we lose the power of the supreme cause, for want of a second cause? It is always removed from any thing that we know. Or must another *subtile matter* be

be invented, that mechanism may have its share in carrying on the *great scheme*? Or must we be forced at length, to admit the immediate action of the Deity? It had been worth while, to have foreseen, and provided against this event. And why should we suppose such a medium without the smallest probability, or foundation in nature; nay contrary to demonstrative arguments? For it was owned before, and that frequently, that gravity (which this *elastic fluid* is supposed to produce) surpasses mere mechanism, or the effects of matter and motion. If one solid substance penetrated another solid substance, one, or both would lose their solidity, and be reduced to nothing. This is a demonstrative reason against the existence of such a medium: experience confirms it, beyond contradiction. Such a *dense fluid* as impelled weighty bodies with such impetuosity, would impede all our motions. We should feel a resistance, as if we moved in a flood of matter, as dense as any body we knew, as dense as gold, if it were liquid. And yet we move freely without any sensible resistance, except from the air. What a dismal confusion would the world be,

be, if framed according to the hypotheses of philosophers!—Now since both reason and experience are against such a fluid, why should it be brought in so often? And why not allow gravity to be owing to the immediate operation of the Deity, since this is supposed concerning the efficacy of an imaginary fluid? Is it to put the operation of the Deity a step farther out of sight? Or is it to render the operation of the Deity disputable, by making it conversant about a thing that hath no existence? Undoubtedly it hath that tendency; and to insist upon it *derogates extremely from the government and influence of the Deity*: For the passage above is continued thus.

IV. “ This however does not hinder,  
 “ but that the same *medium* may be sub-  
 “ ject to the like laws, as other elastic  
 “ fluids, in its actions and vibrations; and  
 “ that, if its nature were better known  
 “ to us, we might make curious and use-  
 “ ful discoveries concerning its effects from  
 “ those laws. It is easy to see *that this*  
 “ *conjecture no way derogates from the go-*  
 “ *vernment and influences of the Deity;*  
 “ while

“ while it leaves us at liberty to pursue  
 “ our enquiries concerning the nature and  
 “ operations of such a *medium*. Whereas  
 “ they who hastily resolve those *powers*  
 “ into immediate *volitions* of the supreme  
 “ cause, without admitting any *intermediate*  
 “ *instruments*, put an end to our enquiries  
 “ at once ; and deprive us of what is pro-  
 “ bably the *most sublime part of philosophy*,  
 “ by representing it to us as imaginary and  
 “ fictitious. By which means, as was ob-  
 “ served above, they hurt those very in-  
 “ terests which they appear so sanguine  
 “ to promote : for the higher we rise in the  
 “ *scale of nature*, towards the supreme  
 “ cause, the views we have from philosophy  
 “ appear more beautiful and extensive.” (b)

One would think, from reading this place,  
 that the end of philosophy were to *enquire*,  
 and *not to find* ; as if *finding* what they  
 enquire for would be a disappointment.  
 The real works in nature, and of which  
 we are certain, are not subtle and artful  
 enough ; except men invent something far-  
 ther, an imaginary *subtile matter*, to ex-  
 ercise their parts.——But are not the works



of the Deity ingenious and artful enough, without this addition ? Do we understand all the power and knowledge displayed in *gravitation*, whereby every particle in the solar system, gravitates towards every other particle in it ? This over-powers the faculties of the greatest philosopher. Is not this artful enough, unless it become contradictory, by pretending that a subtile matter impells every particle an infinite number of ways at once, and incessantly ? Does not the immediate power of the Deity perform the cohesion between all the parts of matter, with an inconceivable subtilty of action ? I cannot stretch this small wire, till the parts of it separate from each other. I can raise, or move, a thousand times the quantity of matter, the subtile fluid and all together. Can this *subtile matter* form an insect ; the bee, the pismire, the gnat ? Can it produce the rose, the nettle, the thistle ? Or, to ask no more questions, *does the subtile matter itself exist ?* If it does not exist, certainly it is needless to investigate its properties, its actions, its vibrations.—— All the advantage that is pretended from this conjecture is, that it leaves us at liberty  
to

to pursue our enquiries concerning the nature and operations of such a *medium*. This is speaking of it as a thing already certain ; than which nothing, I think, can be more ridiculous. It is said, if its nature were better known to us, we might make curious and useful discoveries concerning its effects. On reading this, one would think, that its nature were half known already ; and that nothing was wanting but diligence to complete the theory.—This shews in a very strong light, the disease of hunting after *subtile matters*. It seizes upon the imagination, and the reality of the hypothesis is the least doubt. Some *Cartesians* were so much persuaded of the reality of *their subtile matter*, that they imagined nothing was wanting, but an additional improvement in microscopes, to see the *particulæ striatæ* with their eyes. If one had authority to coin a new word, the proper name for this trouble would be, the *Hylemania* of philosophers.

V. Those who deny the agency of matter (or the existence, I think, of this *medium*) are represented as putting a stop to philosophy. *Whereas* (it is said) *they who hastily*  
I
*resolve*

*resolve these powers, into the immediate volitions of the supreme cause, without admitting any intermediate instruments, put an end to our enquiries at once ; and deprive us of what is probably the most sublime part of philosophy, by representing it as imaginary and fictitious.* This accusation is very groundless. Are not the works in nature as artful, and as well worth inquiring into, if they are the immediate and indefinient work of the Deity, and constantly renewed by him, as if we should suppose them performed by dead matter, by an imaginary fluid ? All the contrivances of art, and subtilty of workmanship, are an endless field of enquiry, where we may exercise our faculties with delight, and admire the power and wisdom of the Creator. This is certainly the most rational, and therefore *the most sublime part of philosophy*, and not searching for *instruments* and *second causes*, when the *first* is it at hand. What ! can we not be mathematicians, or philosophers, but when we are in quest of the powers of a dead substance ! Or cannot the Creator of all things work without such an instrument ! Is it to suppose his power nothing but *mere volition*,

*volition*, if he is not assisted by a sluggish mass! *This cause* only demands our wonder and adoration. *Instruments* and *powers* which cannot be assigned, or will not bear naming, are indeed fictitious and imaginary.

— There is a great, a very great difference, between considering the wonders of the creation, constantly renewed, as the workmanship of the living God, and regarding them only as the productions of mechanism and dead matter; nay of a sort of matter that has no existence. It is an inconceivable pleasure, to see the Creator of heaven and earth constantly working in all the parts of nature, and nature itself daily renewed by *creating power*. Matter is only not produced anew, but all the other wonders are the same. Every man sees as much now, as the first man saw. And shall we only admire what he saw, and not what we ourselves see? We are thus assured of our Creator's existence, and of the continuance of his goodness, and that his power is not antiquated (may I so express it?) We behold his perfections incessantly operating, in restoring the successions of creatures; the same power and wisdom that made the first of every

every species. Does the same lumpish stuff require less formation, less power and art, now, than at the beginning ? To look on the face of nature in this view, gives us rational pleasure ; pleasure founded on demonstration. It is the end of all rational enquiries. It does not hinder, but rather incite us, to enquire into the art of his methods, as far as our faculties can reach ; to admire the variety of the contrivances, and the exactness of the execution. We may apply all that we know of geometry and calculation, till our little knowledge is lost amidst prodigies of art. This is entertainment for the most exalted of created beings. It is a familiar conviction, preventing disputes, and raises inexpressible joy in the mind, to see ourselves the care of Omnipotence, always under his immediate tuition, and to feel his power indefinitely working within us and without us. Can searching after material powers above powers, and the agency of a dead mass, equal this uninterrupted pleasure ? That tends to screen the Deity from us, to turn our attention another way, and only coldly informs us, that he is at the head of a series

of other causes, the first of which, and that which produces the most noble phenomena in nature, we are yet in search of, and which may be found out in after ages. O shame ! is not this saying, that we may come to be convinced that the Deity is at the head of nature in some distant age ? A poor comfort to rational beings ! We must always take it upon trust from philosophers, and be diverted from attending to the conviction that lies before us ; from beholding creating power with our eyes. For this search after *material causes* has been the great business of philosophy, ever since *Democritus's* days ; and must keep us from the knowledge of the Creator, till we begin to see with our own eyes, as the search is made after a thing impossible to be found. But no set of men has laid an embargo upon truth (c).

## VI. The

(c) When it is said here, that “ the higher we rise in “ the *scale of nature*, towards the supreme cause, the “ views we have from philosophy, appear more beautiful and extensive.” We may observe that a *scale of material causes* in philosophy is not like the *rising scale of beings* in the creation : tho’ the supposing a *scale* here seems to have been taken from that. In the *scale of beings*,

VI. The author goes on to distinguish  
*creating from governing power*, and to ascribe,  
 not

*beings*, the beginning is low, and every species rises in perfection as we ascend. There is an amazing variety from dead matter to living spirit : nor does the gradation end there. This is full of instruction and delight. We see ourselves in the middle of the *scale*, and are certain of rising higher, as rational beings were not made for utter extinction. But it is not so in a *scale of material causes*. There are no degrees of perfection in matter. All matter is equally an unactive substance, that resists a change of its state. The higher we had ascended in such a scale, we should have met with the more obscurity. We see it is so in reality to those who pretend to mount this way. The first sort of matter might perhaps have been seen easily ; the second but darkly ; and the third not at all. This had been the way for the Deity to conceal himself. And this is just the view which philosophy endeavours to give us. It is equivocal language, to speak of rising towards the *supreme cause* through a scale of material causes. No philosopher ever yet pointed out the second step of the *scale*. I see a stone fall. I am certain there is but one step here. A fluid that impressed a crushing force on a small piece of matter, would (as has been before observed) have as much overcome my strength to wade through it, as if I had endeavoured to walk in the bottom of an ocean of mercury, or something more dense. Thus we

not only a share, but the whole government of the material universe, to mechanism. It is said, “ the power of gravity, by which  
 “ the celestial bodies persevere in their re-  
 “ volutions, penetrates into the centers of  
 “ the sun and planets, without any dimi-  
 “ nution of virtue, and is extended to im-  
 “ mense distances, decreasing in a regular  
 “ course. Its action is proportional to the  
 “ quantity of solid matter in bodies, and  
 “ not to their surfaces, as is *usual* in me-  
 “ chanical causes. This *power* therefore  
 “ *seems* to surpass mechanism. But what-  
 “ ever we say of this *power*, it could not  
 “ possibly have produced at the beginning,

see their second step is a fiction to divert the attention, and set us a gazing at something that cannot be seen. The views that we have from philosophy, are indeed very dark and mysterious. Philosophers speak of *not excluding the Deity out of nature*, as of a favour. But they endeavour to *exclude* him from every thing we can point out to discover him. They endeavour to make us easy, by telling us, *he is every where active, and every where present* : But at the same time, they try to restrain his activity, to quadrate with their hypotheses, and make him present only, that *subtile matter* may exercise his power and knowledge. Nothing can *derogate more from the government and influences of the Deity*.



“ the regular situation of the orbs, and the  
 “ present disposition of things. Gravity could  
 “ not have determined the planets to move  
 “ from west to east, in orbits nearly circular,  
 “ almost in the same plane ; nor could this  
 “ *power* have projected the comets with all  
 “ variety of directions. If we suppose the  
 “ matter of the system to be accumulated  
 “ in the center *by its gravity*, no mecha-  
 “ nical principle, with the assistance of  
 “ this power of gravity, could separate the  
 “ vast mass, into such parts as the sun and  
 “ planets, and after carrying them into  
 “ their different distances, project them in  
 “ their several directions, preserving still  
 “ the *equality of action and reaction*, or  
 “ the state of the center of gravity of the  
 “ system. Such an excellent structure of  
 “ things could only arise from the con-  
 “ trivance and powerful influences, of an  
 “ intelligent, free, and most potent agent.”  
 Here *gravity* and *mechanical principles* are  
 excluded from the work of creation : or  
 it is shewn that dead matter could not have  
 formed a world. Then it is added, by a  
 strange sort of inference, “ *the same powers*  
 “ therefore, which *at present govern the*  
 O 3 “ *mate-*

“ *material universe*, and conduct its various  
 “ motions, are *very different* from those,  
 “ which were necessary to have produced  
 “ it from nothing, or to have disposed it in  
 “ the admirable form, in which it now  
 “ proceeds.” (d) Here the government of  
 the material universe, and the conducting  
 its various motions, are ascribed to gravity  
 and mechanical principles, which could not  
 create it : and the only reason why they  
 should govern the world, and its various  
 motions, is, because they could not have  
 produced it from nothing, or disposed it in  
 the admirable form in which it now pro-  
 ceeds. Gravity, which some of the expressi-  
 ons in this place make an inherent quality  
 in matter, and mechanical principles, which  
 are necessary consequences of the inactivity  
 of matter, could not have created matter,  
 and disposed it in the present order : there-  
 fore, they govern the world at present, and  
 conduct its various motions. It is taken  
 for granted, that if they did not create the  
 world, they do in fact govern it. This is  
 the very worst reason that could be given.  
 If I misrepresent the author’s sense, I

(d) Page 387.

am

am liable to be severely censured : but it appears to me, that this is a large stride in mathematical reasoning, and the conclusion extremely *derogatory from the government and influences of the Deity*, and against the interests of natural religion (e). But to be more particular.

## VII. We

(e) Besides the absurdity of the conclusion drawn from this argument ; the argument itself is the poorest way of proving the necessity of a creation that ever was made use of for that purpose. If gravity, or a tendency to one place, be an inherent quality in matter, it makes us no wiser to tell us, that this tendency to one place, could not carry the *vast mass* to different places, and project it with different velocities, or in different directions. This is saying nothing, while we seem to be telling things of importance. And if gravity be the effect of an external impression ; it is ridiculous to speak of it as a cause. If I should suppose the *cohesion of parts* a property belonging to matter, and then shew in many words, that this cohesion of parts could not separate the parts, or give them different figures, and place them in different orders ; I should rather seem to mock my readers, than to write seriously. They are other sort of arguments which prove the necessity of creation, against those who maintain the eternity of the world. Such a philosopher would smile at my conclusion, and press me with my own concessions, telling me, if matter per-

VII. We have been often told, that gravity seems to surpass mechanism, and as often been told, that it may be mechanical, or produced by the impulses of a *subtile matter*. This is writing *for* and *against*, to prevent a reply. One of the two must be true.—What is said to shew us what

forms all these things now, which I suppose impossible to be done by it at the beginning, I contradict myself, and see but one half of my own reasoning for the government of the material universe, and the conducting its various motions: that my arguments conclude for time past, as well as time to come; and that matter performed all those wonders from eternity. I should be struck dumb, and hurt a good cause, for want of skill to chuse my topics of proof better.—It was observed before, that nothing is more hurtful to the conviction arising from the adorable wisdom in fitting one thing for another, to answer great and weighty purposes, than supposing that sluggish matter can perform the same wonders: so there is nothing can raise a doubt concerning the certainty of creation, so much, as teaching that mechanical principles, and certain *nameless powers* govern the material universe. These two are but one and the same case. It is an insult on reason to hear how *Lucretius* and *Spinoza* treat *final causes* with contempt. They denied creation as a consequence. And half-thinking youth affect to admire these quacks in philosophy.

gravity

gravity could not perform, is a new kind of reasoning. If it be mechanical, it is needless to tell us what it could not perform: and if it be the immediate power of the Deity, it is absurd to distinguish it from the power that performs all. It would be very surprizing to say, the power which forms the eye now, *is very different* from the power that formed the eye at first; or *very different* from the power that formed the ear. And if gravity be the immediate power of the Deity, the distinction here made is as absurd. Gravity is taken for an inherent power in matter, when it is said, *if we suppose the matter of the system to be accumulated in the center by its gravity, &c.* How could this be, without an external impression, except matter tended by a power inherent in itself to one certain place? For it is absurd to suppose the Deity accumulating all the matter of the system into one place, and leaving it there. When it is added, that *no mechanical principles, with the assistance of this power of gravity, could separate the vast mass, &c.* This is supposing that mechanical principles, with the assistance of gravity, could do every

every thing else. They could not dispose the vast mass in its present order and beauty ; but they could govern the material universe, and conduct its various motions, if once it were digested into parts, and set a going ; as is immediately concluded from these premises. *The same powers therefore, which at present govern the material universe, and conduct its various motions, are very different from those which were necessary to have produced it from nothing, or to have disposed it, in the admirable form, in which it now proceeds.* The powers which could not create nor dispose, were gravity and mechanical principles, which are here said to be very different from creating power ; and to these the government of the material world is ascribed. If gravity be an inherent property in matter, since mechanical principles are the necessary consequences of the inactivity of matter ; then, according to this conclusion, matter does all that we see done in nature. Men have seen nothing of the Deity's performance, these many thousand years, not since the creation. I should appear to all serious men, a scoffing buffoon, if I should ask, where the  
Deity

Deity hath retired to rest? And yet I am justified to ask that absurd question here. The author's method, (as has just now been observed) is indeed the very worst way of shewing the necessity of a creation. No man will suffer himself to be told, that matter performs now, what it was impossible for it to perform at the beginning, and in all time past. It might be said, either matter does not these things now, or it might have done them forever. Thus creation will begin to be doubted of, and looked upon as a legend of past times. Even *Aristotle*, who thought it absurd not to speak of the Deity in his treatise *De Mundo*, yet maintained that the world was eternal and uncreated. If we make the Deity unactive in the world, admitting him into our philosophy, is but purely nominal, and to observe a form. Or let me ask, if the Deity be *active and present every where*, and to no purpose? or, if he *acts every where*, what sort of *powers* they are which want power, and require the action of the Deity, to make them perform the purposes for which they were intended? If so, how can they govern the material universe, and

conduct its motions? *Conduct* belongs to intelligence. And if, at last, they are the powers of the Deity, his governing power is not different from his creating power, but in our way of conception; it is one and the same power, exerted in different manners. To say, the power which forms the eye just now, is *very different* from the power which formed the eye at first, or that the one was an immediate effect of infinite power, and the other of matter and mechanical principles; is to vilify even creating power, while we appear to extoll it, by bringing it so low as matter and mechanism.—We are on our guard against *Des Cartes, Spinoza, Hobbes*, and others, who taught professedly such principles: but to bring them in, where we least expected them, takes us unprovided; and is the highest injury that ever was offered to the memory of a great man.

VIII. Let us only reflect on what we see constantly done before our eyes, and we must be familiarly convinced, that the governing power of the Deity is only his creating power constantly repeated. In the *renewing of the year*, as it is called, what  
is



is it we behold ? The herbs, and flowers, and fruits, decay and perish ; or they are consumed by man and beast. They are succeeded by a new production, every season, every day, continually. Is not this a new creation ?——I should expect an answer to this question, if I were speaking to any man, who had considered the thing with due attention. Did the first man see any other sight than this ? The sight was new to him ; it is habitual to us. This makes no difference in the thing seen, whether we behold it with a joyful sense of the wonder, or with hardened inattention. Let us suppose a man just created, when the year is in its prime (as we say) with the knowledge and sense that the first man had ; and his surprise, joy and gratitude would be the same, as the first man's was.——A grain of seed is cast into the ground, and sixty, seventy, sometimes an hundred such grains arise. What shall we call this miraculous multiplication, if not a *new creation* ? What arises is not, and cannot be, what was cast into the ground. Is not the infinite art and power, in renewing the works of creation, equal to creating art and  
 creating

creating power? It is only creation frequently, very frequently repeated. What if the seed lay in the ground, eight, ten, or twelve years, without any thing appearing ; but a wonderful multiplication arose at last ? Every heart would rejoice, and every tongue acknowledge *creating power*. And does the frequency of an act diminish the power of the act ? To think so, is not just reasoning. If this miracle were repeated every four and twenty hours, we should behold it still with greater indifference and neglect.

——This power is repeated, not in one kind of things only, but in a variety, and with an universality, that fatigues the thought, to pursue the different species, in all places. Why then do we make the power that governs the universe *very different* from the power that created it ? Matter is only not produced anew, as was said : but all the other wonders, all the other art and power, are the same, as in the first production of things. Matter needed be created but once ; but it was necessary that the art and power should be constantly repeated. This constant repetition of creating art and creating power, is called the *course of nature*,

*nature*, by an expression that disguises the truth. The performing these wonders once in a dead substance, was not enough to make that substance perform them a second time, and for ever after. Matter never becomes more docile, or less resisting to all change of the state it is in. If a change is produced in it, by an external cause, it resists a change of that state, as much as it did the former, till its resistance is overcome a second time ; and so on continually.

IX. And all this is at least as applicable to the production of living creatures, as of vegetables ; as every man of the plainest sense must see.——It is not perhaps proper to make a comparison between one performance of the Creator and another, in respect of *art* and *power* : and yet the producing living creatures successively, as the former go off, the raising up the innumerable individuals, in all the tribes of animals, to supply the place of the former, must appear to us a *renewing of the creation*, still more wonderful, than the renewing the successions of vegetables, which are rooted fast in the earth. We see the beasts of the field, the

the fowls of the air, the fishes in the waters, begin to exist ; they did not exist before. What is a new existence, if it be not a new creation (*f*) ? Let us reflect that the

(*f*) It was before observed, that all flesh is but grafts ; and grafts is but the different formation of the same mass of rude matter. When we consider this common expression in our own minds, we find it to be a literal truth. The *power* and *art* therefore, which forms out of the same common mould, such a variety of animal bodies, must appear to us at least, equal to the power by which that mould was at first produced. May I venture to go farther and say, that the production at first was a pure act of Omnipotence ; but the forming out of it such a diversity of animal bodies, all fitted to various sorts of spontaneous motion, to be informed by a living substance, and from a dead lump to become a moving system, to be kept in repair by a constant circulation of different sorts of fluids throughout the whole structure ; that all this, I say, shews equal power, directed by incomprehensible knowledge and wisdom ? All men, I think, are forced to conceive the first production of substance (material or immaterial) as a *transient act* of power ; we cannot imagine substance growing by parts : but these are continued exertions of the same power ; what the schools call *immanent acts* of power. And tho' we cannot say that our conceptions, concerning the exertion of infinite power, are adequate in either case ; yet, since they are not absurd, why should we conclude directly against them,

the bare production of matter did not finish the work of creation. It required moreover that the bodies of all things that have life, and the whole vegetable creation, should be formed out of the common mass. And the species were to be continued, while the present nature of things remained. The individuals were not to be lasting, like the sun and planets, and the other great bodies of the universe : but the species were to be as durable. They were to be continued by the successions of individuals one after another. And as long as this formation continues, so long the work of creation must last ; since matter can no more perform that work now, than it could have done several thousand years ago. We distinguish the creation of things from their preservation. This is rather a popular prejudice, than the suspension of creating power. It was observed before, when we saw that mechanism was not the effect of matter and motion, that the continuation of the existence

them, and say, that the governing power of the Deity is very different from his creating power ? We run the greatest hazard of being absurd by concluding contrary to our conceptions.

of matter itself, requires the constant action of the Deity. The reasons may be there seen. The preservation of matter therefore (and of every created substance) is the same creating power still continued. But tho' we should distinguish the creation of an individual living creature from its preservation; this distinction will not extend from one individual to another. The preservation of the father, is not the giving existence to the son. The son has a distinct existence of his own. And thus it is in every succession, not only of man, but of all living creatures. The preservation of any one individual, cannot be either the preservation, or production of the next that follows. Creating power must be called into that act: and the continuance of the species, in every kind, both of animals and vegetables, is performed by such acts of creating power.

X. That we may see this truth in a more familiar manner, I would ask, what if all the species of animals on the earth were extinguished, and lost? Could matter and mechanism produce again the same, or other kinds

kinds anew, out of the same common mass? I do not think that any man would affirm this, because the consequences are obvious. Then I would ask a reason, why matter and mechanism could not raise up again all sorts of living creatures, tho' all the kinds of them were quite lost? It would be answered, because they would then want a seed to spring from. I ask therefore again, If matter and mechanism produces this seed? Here I must wait for an answer. A man who had considered the inactivity of matter, that it necessarily resists all change of the state it is in; and that *mechanism* is but a name for the artful configuration and disposition of the parts of the same matter, which could not be supposed done without an external and intelligent cause; since the *artful configuration and disposition of parts*, imply such a cause in the conception of them: a man, I say, who had considered these plain truths, would answer me, that matter could not produce this seed now, more than in the first formation of things; and that mechanism does not belong to the case, as I proposed it, as supposing that an intelligent cause had already prevented the question.

Another man who had not considered these truths, if he loved truth, could be easily made to see all their force and conviction.——To return then to the subject ; I would next observe to such a man, that tho' all living creatures are not extinguished at once ; yet they are all extinguished by parts ; so that in a short term of years, they are as effectually cut off, as if they had perished by some universal catastrophe ; and that those seeds to which he at first ascribed the continuation of the species, required the artful configuration and disposition of the parts of matter, by an external, that is by an immaterial cause ; and that is by the same cause that formed animals at first, or by the Creator of all things. And moreover, that *mechanism*, when rightly understood (as he justly observed) was no cause, but the effect of an immaterial cause, and that matter after all the configuration and disposition of its parts, still remained matter, *i. e.* an unactive substance, which required living power both so to *dispose* it, and to *act* upon it afterwards, and continually. Whence it followed, that the continuation of the species both of animals and  
 vege-



vegetables, was literally a constant repetition of the acts of creating power (g).

# XI. But

(g) It may perhaps be asked here, as in a like case before concerning mechanism, why doth the Creator then take this method of raising both animals and vegetables from seeds, if the seeds are no way conducive, or of use in forming the future animal or vegetable? To this it is sufficient to answer, that we have nothing to complain of. We see his *creating art* and *power* more evidently this way, than we could have done in any other. And no method possible could have been taken, which we might not have questioned in the same manner. As has been said in another place, there is no guarding the methods of infinite knowledge, against the exceptions of ignorance, or of our own inattention. The first formation of *these* seeds, before they come within our view, shews beings higher than we, and in a more perfect state, the fineness of art by which the Creator forms the rudiments of the animal body. And after they come under our observation, we see the miracles of contrivance used by the Deity. This rational pleasure we should have been deprived of, had living creatures and vegetables been raised without such a process. The Creator was under no necessity to use this method, since in the formation of the first individuals, he wrought in a different manner; and then established the method which was to be the *course of nature* afterwards. This was not giving up his power and knowledge to a dead substance, which can never become either active or intelligent. It was only

XI. But there is a particular to be considered here, which raises the government of

settling a constant form of proceeding, that we might not be at a loss to guess what was to happen, and that our own industry might be interested. For animals, in this method of succession, were to stand in the relation of *parents* and *off-spring* to one another. We see that this was not necessary : otherwise the successions had either been eternal, and without beginning, or absolutely impossible. The first of every species could not be the *off-spring* of others.—This method then was a wise choice, to lay the foundation of society among men, and makes the cultivation of the rational nature the work of rational creatures themselves, and not an act of mere power by the Deity. That had not been a rational method, by the very conception of it. In the first of the human race it was necessary ; afterwards it had been absurd. We begin very low, from the confines of the brute nature ; but rise high, as we advance in existence, or duration, except by our own fault. Reason improved by an act of power, is a repugnancy in thought.—This method makes room for all those wonderful *instincts* in the inferior creatures, in providing for their future progeny, before they know them, which is the admiration of intelligent beings. They act by a reason, not their own ; and far superior to ours. Who would chuse to give up this constant demonstration of the goodness and condescension of the Deity ! The Creator is the immediate tutor  
of

of the material world higher still. These systems of rude matter, thus formed by infinite power and wisdom, are to be united to living beings. As the scale of the creation rises, from dead matter to living spirit, and the uniting these two substances of opposite natures together, was to be the transition from the one to the other ; so the government of the material universe rises to the power and knowledge by which this union is performed. Does matter and mechanical principles furnish the embryo with the living spirit ? Does matter bring immaterial being to the yoke ? And if I may so express it : perform the union, and prescribe the manner in which they are to affect each other ? Does it endue the organized systems with their various *instincts* and govern them so unerringly ? This is a part of the government of the material world. It concerns a philosopher to think of this,

of those low creatures ; and acts (if I might say so) in a double capacity to them at once. These instances of his *goodness*, *power*, and *wisdom*, we could not have seen, if living creatures had not stood in the relation of *parents* and *off-spring* to each other, or had not been produced by seeds.

before he pronounce so hardily. We have been told of *many powers in nature analogous to gravity* ; but no power exerted upon mere matter is applicable in this case.

——The government of the material world is an arduous task ! it comprehends more than gravitation, or attractions of any kind. It extends to the union of the rational soul, and an unactive dead substance, and to the constant direction of spontaneous beings. This work is to be done, at the formation of every living creature, not only of the human species, but of all the various tribes of animals in the earth, sea, or air. This is constant experience. Might I go so low, without offending the dignity of the subject ; every house-wife is witness to it, while a chick is hatched. But really, if we would contemplate nature, no observation is low ; and the more common the better. We cannot hinder ourselves in such a case to think on the *instincts* of the fishes in the waters, tho' we despise them. They have their migrations as well as the fowls of the air. They travel in companies to distant coasts, for the sake of a succession to keep up the species, which they are never  
to

to see, and know nothing of. They all agree without voice, or signal, and undertake the voyage, without communication one with another. They know nothing of the course of the stars, or things observed above the surface of their element ; nor do they see their way. The variously refracted rays disturb that sense. These voyages below water *Herodotus* took notice of many ages ago. The slow tortoise travels to dry land, that its issue may be out of the reach of the waves. The heat of the sand is to perform the office of incubation. The earth-worm rises above ground, to meet its male at the appointed time, and to catch the dew : but it shrinks into its hole at the least trembling of the surface. Feeling is all the sense it is provided with.

XII. All nature is full of the instances of this government, which rises above the action of immaterial power upon the unanimated parts of matter. Why should not these be taken into consideration, when we compare *governing* with *creating power* ? We live by those new productions, mentioned above. They are the constant occupation of the greatest

greatest part of mankind. The reasons here are adapted to the capacities of all men, and satisfactory. We are best acquainted with the things round us on this earth. Why then do philosophers carry us always up to the sun and planets ; as if the material world needed no government elsewhere ? Why do they not apply their arguments to the common sense of mankind, when the subject itself invites them ? Every man is capable of seeing truth, when fairly deduced : and philosophy should be no mystery.—— But if we consider the motions of the great bodies in nature, and reason justly from them, we shall find no ground for ascribing the creation of the material world to one power, and the conducting of these motions to other *different powers*. The centripetal force whereby these bodies gravitate to one another, must be as much impressed upon them every moment, as it was the first moment they began to move. It is only the uninterrupted exertion of the same power. If it were not constant, they would always fly off in straight lines. Bodies resist a change of the direction of their motion, as much as a change of their state  
of

of motion. It is therefore this indefinient impression of the power of the Almighty, that makes them move in curves of any kind. So little reason is there for distinguishing the governing from the creating power, in conducting these motions. It is the same power put forth more variously in the first disposition, and continued ever after in a regular and uniform manner.——*Action* and *reaction* is again mentioned in the place cited. But it was shewn before, that in the mutual gravitation of two bodies to each other, there is no *action* and *reaction* of the one upon the other ; but two different actions that have no communication, or two different impressions of immaterial power. And it is absurd to suppose action and reaction between immaterial power and matter.—— As to the path of secondary planets, which fell in to be considered, from the point of equal gravitation of the moon towards the sun and our earth ; it shall be shewn immediately how much this particular is endeavoured to be disguised by ill applied geometry.

XIII. This subject of the government of the universe is concluded thus. “ Nor

“ is there any thing extraordinary here re-  
 “ presented, concerning the manner in  
 “ which the *supreme cause* acts in the uni-  
 “ verse, by employing *subordinate instru-*  
 “ *ments* and *agents*, which are allowed to  
 “ have their proper force and efficacy; for  
 “ this we know is the case in the common  
 “ course of nature, where we find *gravity*,  
 “ *attraction*, *repulsion*, &c. constantly  
 “ combined and compounded with the  
 “ principles of mechanism.” (b) This apo-  
 logy is as weak, as the scheme which it  
 apologizes for, is without foundation. It is  
 not indeed extraordinary, to find the man-  
 ner in which the *supreme cause* acts in the  
 universe misrepresented by philosophers, of  
 which this author has frequently taken  
 notice; but that does not justify such a repre-  
 sentation. Example is no excuse, and ex-  
 claiming against others a thin artifice.—  
 Employing *subordinate instruments* and  
*agents*, is a mark of weakness among men,  
 whose power and presence is much limited.  
 The Deity hath no need of them, who is  
*every where active* and *every where present*. It  
 is superfluous to give such a being *subordinate*

(b) Page 389.

*agents* ;



*agents* ; and repugnant to give him such *agents*, as he must continually actuate and influence. There is no propriety, nor justness of thought, when it is said, “ The supreme cause *acts* in the universe by *employing* subordinate agents. *To act* by employing, is *not to act*, but to commission others to act for us. Is the Deity only like a great man, who employs other men to act for him, in distant places where he himself cannot be present ; or at times when he is otherwise occupied ? The case is different in every respect. Those other men are just such beings as he who employs them. The Deity is every where present, and every where powerful ; and matter is only passive, and without power to act. It is a compliment payed to a great man, to say he does what other men do for him. Is this only a titular respect shewn to the *supreme cause*, to ascribe to him what other agents do ? Certainly, *to act by employing subordinate agents*, is an honorable title of impotence.—In mechanism, men help their weakness with the impressions made on matter by immaterial power ; such as *gravity*, *elasticity*, *repulse*. No machine was ever made without

without this assistance from living force impressed on dead matter. We call it *art*, thus to cover our impotence with borrowed power. Philosophers have ridiculously supposed that such a needy shift must be *art* in the Deity : they have imagined from the first ages, and do still imagine, that what is a mark of weakness in mankind, must be a perfection in Omnipotence ! hence *subordinate agents* and *second causes*, have been borrowed from the moral government of the world, and introduced into the government of the material universe. The language became popular (as I have observed before) till at length *second causes* and *instruments* were so much employed by those people, that they did all ; and the government of the Creator became only nominal, or was entirely antiquated. That man was no great philosopher, who did not solve every appearance by matter and motion. *Des Cartes* had a flourishing reputation for many years, and still has in many places. A Creator was even thought needless, not only by the *Epicureans*, but the *Peripatetics* thought there was no occasion for one. If I should be wrong in all this, I expect to be set right.

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—The popularity of the words, in the place I have cited, is all the argument contained in it.

XIV. It would have made this plain, if the *agents* and *instruments*, which are employed, had been named. It is really strange, to have talked so much of *powers*, *second causes*, *instruments*, and *subordinate agents*, without naming any of them. Are we to give up the immediate government of the Deity in the material world to popular words, and bare authority? It is too much to be expected, except reasons were likewise offered. — *Agent* and *instrument*, are as opposite, as *power* and *instrument*, which were spoken of before; tho' they are brought in here, as if they were of the same nature. The *agent* uses; the *instrument* is the thing used. Matter can neither be the one nor the other, to the Deity. It would be an *unactive agent*, which sounds not well: or rather a *resisting impeding agent*, which is still more improper for producing an effect. — Nor can matter be an instrument to the Deity. An instrument facilitates the work to the agent, and implies want of power

power to perform the thing to be done, without such an help. This is the nature of *instrument*, which shews us how improper it is, to apply this *help* to the Deity. An unactive substance cannot facilitate the operations in nature. The more such an instrument were employed, so much the more operose and difficult we must conceive the work to be. To imagine that it shews so much the more art to chuse the most difficult method, is reading nature backwards. The Deity is not liable to our vanity. A man might thus chuse to shew his art, by walking on stilts. The simplicity of the method is the beauty in the works of nature.—But chiefly, matter is the thing to be wrought upon, and cannot be the instrument to work upon itself. Matter is the substance to be fashioned and formed ten thousand different ways. An instrument was never made use of to form itself. What instrument had the Creator in the first formation of things? All matter, without exception, is thus to be fashioned; and other matter could not be employed in this work. The form of the same matter is constantly changed, in animal bodies,  
and

and vegetable substances, in all the elements. Are instruments constantly employed? This will make the matter employed as instruments, more in quantity, than the matter that is wrought upon : as was observed before concerning the subtile matter that was to produce gravity.——A carpenter cuts, shapes, and forms his work by the help of his tools. This is a mark of want of power to do otherwise. He could not work so with his unassisted hands. Is this defect applicable to the Deity in renewing the works of creation : How absurd would it be to say, The Creator forms the eye, or the ear, or works up the *fetus*, by the help of other matter ! one part of matter could only move another part, by the resistance it makes to change its state. This is a round-about method. It requires more motive force, and more room, to employ dead instruments about the part to be moved, instead of active power. It conveys a strange idea to the mind, to imagine many particles employed, to mould or fashion another particle. The power must therefore be applied immediately to the part itself.——We employ a wedge to *cleave*, a

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screw

screw to *press*, a wheel to *raise up*, a lever to *move*. Is the Deity reduced to these necessities, to divide matter by matter, or to raise weight by weight? or to employ a borrowed power? Can he use any power but his own? Who is it that makes cohesion, that makes gravity or weight? Is not this power sufficient, without an instrument of matter?——Dare I observe, that the philosopher's Deity seems to be made up of human infirmities?

XV. Or does the Deity *act*, and do these agents and instruments *co-operate* with him? It is said, They have *their proper force and efficacy*. How came they to be possessed of this force? Matter has no force, but that of resisting a change of its state, which is incompatible with any other force or efficacy; or it is a plain exclusion of them. What proper efficacy has it then? All this is untelligible and contradictory. It is foolish (as hath been observed) to imagine the Deity using his own power at second hand.——*Gravity, attraction, and repulse*, which are mentioned here, are neither *agent*, nor *instruments*; but the immediate impressions  
 I of

of immaterial power. It is said, they are compounded in the common course of nature, with the principles of mechanism. This is said without reflection. The impression of the power is immediate, and antecedent to all principles whatever, except to knowledge and design. If the impression of the power were mechanical, the *common course of nature* would be mechanical. The Deity himself could do nothing but mechanically, that is, necessarily, or as motion is conveyed in mechanism from one part of the machine to another. This is literally *Spinoza's* doctrine, which I wish the author had considered better. Let us take a common example. In a watch the elasticity of the spring impresses force on the barrel, or first part to be moved. This impression is above the *principles of mechanism*, and altogether independent of any mechanical structure: for the spring extends itself at any time, and impresses force on any obstacle. The force impressed is communicated from one part to another, still diminished, till the index is moved. This communication of the force, by the skillful configuration, and joining of the parts,

is all that is mechanical. And, as has been said, it is a mark of our weakness, thus to be obliged to help ourselves with a borrowed power, and to study how it may be communicated from one part to another. Now the Deity is not liable to such imperfection; nor would it be art in him, to use such a laborious communication of his own power from one part to another. It is equally applicable to every part to be moved. This (I must repeat it again) is the great mistake of all philosophers, to suppose the Deity liable to our necessitous shifts, or that to be art in him, which is weakness in us.—To say, we find, in the common course of nature, *gravity*, *attraction* and *repulse*, constantly combined and compounded with the *principles of mechanism*, is just saying, that we find the immediate power of the Deity combined and compounded with the necessary consequences of the inactivity of matter: for such are the principles of mechanism, or the three laws of motion. We should write nothing but what we have a distinct conception of ourselves.—The *course of nature* is lightly named, as a common thing. Nothing is so common: but it is no less, than the constant



stant repetition of the acts of the Divine power and art, in renewing the works of the Creation, as hath been shewn.—

To have done with this subject; if we rightly consider the inactivity of matter, we must see the constancy and universality of creating power, in governing the material universe. We think it is of no great moment in studying the works of nature what notions we have of the Deity, provided we are furnished with mathematical learning. It would be needless to put me upon shewing, how trusting to that sort of learning alone, has misled many a great man in studying the works of nature. Thus a mistake in the use of the best things, becomes the most hurtful.

*The general Argument.*

*Which proves the existence of all things external to the mind itself.*

**T**HUS I have endeavoured to vindicate the government of the Deity in the material universe, and to clear up the principles I had laid down before. What I had answered to these, and other such like objections, in the notes to the first part of the Enquiry, has either not been considered, or authority has been thought sufficient to bear down reason. The principles still seem to me a sure foundation to proceed upon, in shewing the *immortality of the soul*. And for the same reason I intreat the reader's attention for a moment longer, till I lay before him a confirmation of the arguments by which I inferred the *existence of separate spirits*, from what we see and suffer involuntarily in our sleep. This author, who opposed that reasoning at first, has now carried it to a far greater extent than I did, and shewn the existence of all external things, both corporeal and incorporeal, from

from the same argument ; and very justly, as it appears to me : the ingenious no doubt will try if it can bear examination, or if a better argument can be found for the existence of the material world, and all things in it.—— The passage is as follows.

II. “ As we are certain of our own existence, and of that of our ideas by *internal consciousness* ; so we are satisfied by the same consciousness, that there are *objects, powers, or causes*, without us, and that they act upon us. For in many of our ideas, particularly those that are accompanied with pain, the mind must be passive, and receive the impressions (which are involuntary) from external causes or instruments, that depend not upon us. We easily distinguish these objects into two general classes. The first is of those which we perceive to have *spontaneity, or self-moving power*, and several properties and affections, similar to those of our own minds ; such as *reasoning, judging, willing, loving, bating, &c.* The second general class is of those in which no such affections appear,

“ pear, but which are so far of a passive  
 “ nature, that they never move themselves;  
 “ neither, when they are in motion, do  
 “ they ever stop without some external in-  
 “ fluence. If one of these move out of its  
 “ place, without the appearance of a mover,  
 “ we immediately conclude, that this is  
 “ owing to some *invisible agent* (a).”

III. I need not add a comment upon this place, to a reader who sees the force of an argument at first view. He will soon observe, that the existence of all things without the mind itself, material and immaterial, is concluded here, from no other reason, than that from which I inferred the existence of *separate living beings*, which obtrude upon us the objects we see in our sleep, and the things we hear then. . Whatever other obscurity there may be in this appearance, thus far is certain. If this reason is sufficient to shew us the existence of heaven and earth, and all things in them, and the existence of spirits themselves, endued with the same powers and faculties, as our own ; it must, by a close parity, shew us the ex-

(a) Page 97.

istence

istence of *separate spirits*, which represent to us a greater variety of objects while we sleep, and more wonderful, than what our waking senses inform us of. For if the soul must be *passive* in our involuntary waking perceptions; to say it might be *active* in producing the like involuntary perceptions in itself then, which it feels forced upon it, and which give it often much pain; and this without knowing that it did so, but being conscious that another being put it in this fright and disorder: this, I say, overturns all the evidence we can have from consciousness, and the certainty of the existence of every thing in nature, except of our own mind—It is impossible to describe the confusion that would follow from this. It makes all our actions and life, a constant illusion upon us. If we *do* what we are conscious we *do not*, we may *not do* what we are conscious we *do*. We could not thus be certain that we are *ourselves*, or the same conscious beings we were the minute before. Scepticism was never carried to such an extravagant height as this. It takes away all certainty even of demonstrative truth and knowledge: for we may *not perceive*

*perceive* what we *do perceive*, as well in the one case, as in the other.

IV. These are monstrous absurdities; and it would be unaccountable obstinacy to allow them, rather than own the existence of *separate spirits*. This would justify our denying the whole material frame of nature, and all the objects in it, as was formally done not many years ago, by a person from whom it could have been least expected: nay, and the denying all demonstrative truth. For all depends upon knowing our consciousness to be *our* consciousness. *Pyrrho* was in the right, after he set out in this manner, to make thorough work of it. He would not allow the dogs which bit and tore him, to be any thing at all. This was sticking close to his own system.—— It is justly observed in the place cited, that the first general class of objects without the mind itself, is of those which have *spontaneity*, or *self-moving power*, with other faculties similar to those we find in our own minds. The second species is only of inactive objects, or bodies. The certainty of *active* and *perceptible* beings, is first in the

the order of nature. They make themselves known by their *activity*. An unactive object cannot make itself known, but by means of some change of its state, which must be wrought in it by some *invisible agent*, as the author observes. These beings are percipient in greater perfection than we. This we know by the conversations we hold in sleep. Their replies are apposite to what we say. They know the thoughts of our hearts without the communication of language. This is wonderful! It can as little be denied, as the manner of it understood by us in this present state, till we ourselves are separate spirits. — Do they understand our thoughts only, while we are asleep? This question deserves to be considered. If so, it challenges something more than wonder. Their power is also far above ours in all respects. When one reads a book in his sleep, the subject of which is familiar to him, and wonders on awakening, whence this instantaneous knowledge came; it infers something more than the bare existence of *separate spirits*.

V. This

V. This is a real and constant appearance in nature. Why should not philosophers have enquired into it, rather than have searched for *subtile matter* that performed all wonders : besides the authority I borrow from this author, all antiquity is full of the consequences drawn from this *phænomenon*. I gave examples from what happened to *Sylla, Lucullus, Astyages, Dion, Brutus*. Some persons may perhaps have the curiosity to read what *Ammianus Marcellinus* says on this head, on account of what happened to the emperor *Constantius* before his death. Where he quotes two remarkable lines from *Menander*, the best of *Greek* poets, if we may believe *Quintilian*. I shall transcribe them to excite the reader's curiosity.

Ἄπαντι Δαίμων ἄνδρι τῷ γενομένῳ  
Ἄπαντος ἐστὶ μυσταγωγὸς τῷ βίῳ.

—But let the conclusion this ingenious person draws, stand or fall, according to the evidence such instances bring along with them ; the existence of separate spirits is at least certain. The intelligent reader (all these things considered) will not deem me rash,  
I when



when afterward I take this for a truth firmly demonstrated. If men had not been too fond of material causes, this had been a received principle in philosophy, as well as a vulgar notion, many ages ago. We all wish to exist in such a state: and yet we are afraid of being certain that any such beings exist there before us. It is the most desirable part of knowledge. And it lies most open to us, as all things most necessary to be known are most easy to be seen. It is justly observed by *Seneca*, *that what is most difficult to be discovered, is least worth discovering* (b). We deny what we might easily see: and affirm strongly what we can never see.

(b) *Nec de malignitate naturæ queri possumus: quia nullius rei difficilis inventio est, nisi cujus hic unus inventæ fructus est, invenisse. Quicquid nos meliores beatioreſque faciendum est, aut in aperto, aut in proximo posuit. De Beneficiis, Lib. 7.*

## S E C T. VIII.

*Shewing that if the moon's gravitation were greater towards the sun, than towards the earth at the conjunction, she must necessarily abandon the earth. The arguments, experiments, and geometry, brought to prove the contrary, examined.*

**I**F a body yielded to a less force in opposition to a greater, or if a weak force might overcome a stronger, men would not know what to trust to in mechanics, or in any other demonstrative science. If the sun's force upon the moon be double, triple, or quadruple the earth's force upon her, when she is between them, the equal forces on both sides suspending each other, a great excess of force must act on that side, against no force at all on the other: And that the moon should yield to no force at all, contrary to this gravitation towards the sun, is a manifest absurdity. Yet this is pretended to be shewn true in fact, and to be proved both from reason and vulgar experiment, as also by geometrical demonstration. I shall

shall beg leave to consider these arguments, in the plainest manner I am capable, that those who have curiosity enough to read such things, may do it without trouble.

II. A figure will represent the matter in question to the eye, better than many words could do, so that it may be easily understood by any person. In this figure, *S* is the sun, *M* the moon in the conjunction, *E* the earth; the points concentric to the sun signify the gravitation towards him, extending every way round, through the whole solar system: the points about the earth mark the gravitation towards the earth, which it is allowed does not reach so far as the moon, according to the parallax commonly supposed. *A* is the limit, or *point of equal attraction*, between the sun and earth; where if a body were placed, it would be equally attracted to both, but could move towards neither; the contrary and equal forces balancing each other. If the body were nearer the earth than that point, the gravitation towards the earth would prevail, and carry it that way. If it were without that point, as the moon is in the figure, the

the sun's greater force would prevail, and draw it from the earth. Which already shews us the event between the unequal forces, without any artful reasoning, or disguise.—It is proper here to add, that the sun's parallax is only the angle, which the semidiameter of the earth would subtend at the distance of the sun. Therefore if the sun's distance be very great, that angle must be very small, and the quantity of matter in the sun must be very great; since he appears so large to us at a great distance. And contrarily, if his distance be less, that angle must be greater, as he is nearer to us; and his quantity of matter must be less, since he appears no larger at a small distance. From this it follows, that *the point of equal attraction* between him and the earth, must be nearer the earth, or farther from it, as the quantity of matter in the sun, is supposed more or less. For the greater the quantity of matter in the sun is, with respect to the quantity of matter in the earth, the more his attractive force must prevail over that of the earth; and contrarily (a).

III. The

(a) The attractive force towards the sun increases

III. The point in dispute is briefly, but justly enough represented in the following words. " Because the gravity of the moon  
 " towards the sun, is found to be greater  
 " at the conjunction, than her gravity to-  
 " wards the earth, so that the *Point of equal*  
 " *attraction*, where these two powers would  
 " sustain each other, falls between the  
 " moon and earth ; some have apprehend-  
 " ed, that either the parallax of the sun is  
 " very different from that which is assign-  
 " ed by astronomers; or that the moon  
 " ought necessarily to abandon the earth.  
 " This apprehension may be easily remov-  
 " ed." &c. (b)——This is the state of  
 the question in general terms, and the

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appre-

as his quantity of matter is supposed greater, *i. e.* as the cube of his distance is supposed to increase : but it decreases only as the square of that distance. Thus as we suppose his distance greater, the gravitation towards him increases more from the greater quantity of matter, than it decreases from the greater distance. Therefore the point of equal attraction between the earth and him, draws nearer the earth, as his distance, or parallax is supposed greater.

(b) Account of Sir *Isaac Newton's* philosophical discoveries, book 4. ch. 5. page 336.

apprehension of the consequences is thought to be without foundation, and easy to be removed ; which I shall here enquire into.

IV. Now it follows from what is said in the annotation at the end of *Matbo*, the book here referred to, that if the sun's parallax be only 6 seconds, as *Monsieur De la Hire* makes it, his force upon the moon, when in the conjunction, is almost quadruple of the earth's force upon her. Or if the parallax be 10 seconds, as is commonly supposed, the sun's force on the moon is still nearly twice as strong as the earth's force on her ; for they are to each other as 1, 92 to 1. This stronger force therefore should draw the moon down towards the sun : whereas we see the earth draws her upward from the sun. And this author himself, speaking of the sun's force on the primary planets and their satellites, says elsewhere, " a very small inequality in the accelerating forces that act on the primary planet and its satellite, would produce very great irregularities in their motions." (c) Now why should not this observation hold in the present

(c) Page 274 of the same work.

present case ? For according to it, if the sun attracts the moon with twice as much force downward, as the earth does upward, such a great inequality must produce a more remarkable irregularity in the motion of the moon, and separate her from the earth forever. If an inequality of force produced an irregularity of motion in the one case, it must do so in the other. The sun acting on the earth and moon unequally, and the sun and earth acting on the moon unequally, and in opposite directions, must have the same effect in producing an irregularity of motion : or rather the irregularity of the moon's motion must be much greater in the last case.——This is only arguing from what the author asserts elsewhere. And in the present case he allows, that the stronger force of the sun would prevail, and carry off the moon from the earth ; but pretends to find a reason which prevents this terrible event. The place is very remarkable. He says,

V. “ But it may contribute towards removing this difficulty, to observe, that if the absolute velocity of the moon, at

“ the conjunction, was less than that which  
 “ is requisite to carry a body in a circle  
 “ there around the sun ; supposing this  
 “ body to be acted on by the same force,  
 “ which acts there on the moon, (i. e. by  
 “ the excess of her gravity towards the sun,  
 “ above her gravity towards the earth ;)  
 “ *then the moon would indeed abandon the*  
 “ *earth.* For in that case, the moon hav-  
 “ ing less velocity than would be necessary  
 “ to prevent her from descending within  
 “ that circle, she should approach to the  
 “ sun, and recede from the earth. But tho’  
 “ the absolute velocity of the moon at the  
 “ conjunction, be less than the velocity of  
 “ the earth in the annual orbit ; yet her gra-  
 “ vity towards the sun is so much diminished  
 “ by her gravity towards the earth, that  
 “ her absolute velocity is still much supe-  
 “ rior to that which is requisite to carry a  
 “ body there in a circle about the sun,  
 “ that is acted on by the remaining force  
 “ only. Therefore from the moment of  
 “ the conjunction the moon is carried with-  
 “ out such a circle, receding continually  
 “ from the sun, to greater and greater  
 “ distances.” (c)



: VI. Here it is granted that *the moon would indeed abandon the earth*, by being more strongly attracted to the sun, than to the earth ; were it not that her velocity is greater than what is requisite to carry a body about the sun, in a circle, at that distance ; if it be impelled only towards the sun with the excess of the two opposite forces. But this reasoning is wrong in more respects than one. For first, it is not said here, *how much* the sun's attractive force on the moon is diminished by the earth's contrary attraction. The sun's remaining force therefore should have been determined, before any just conclusion could have been drawn from it. For any thing that is here said, the moon's velocity may rather be too little, than too great, to carry her round the sun in a circle, at that distance. Formerly it was asserted, " that the moon's course might be " preserved regular about the sun, tho' she " were a thousand times more attracted to- " wards the sun, than to the earth." (d) In that case her gravitation towards the sun would have been diminished but one thou-

(d) See conference seventh, Numb. 100 of the *English Matho.*

sandth part, by the earth's contrary force : and then certainly her velocity had been less than requisite, to carry her round the sun in a circle, being attracted by such superiority of force.——Or if the sun's parallax be but 6 seconds, her gravity towards the sun would still be almost four times as great, as towards the earth: or tho' the parallax should be 10 seconds, it is still nearly twice as great. Now unless it had been argued from some particular parallax, or distance of the sun from the earth, we cannot say *how much* the sun's force on the moon is diminished by the earth's contrary force.

VII. But supposing that the moon's velocity were greater at the conjunction, than what were necessary to carry her round the sun in a circle at that distance, being acted on by the excess of the sun's force above the earth's, and allowing the parallax to be 10 seconds; yet since the tangential force there, is at right angles to a line drawn from the sun, or to his gravitating force upon her, that *excess* of force would bend her path downwards, or below the tangent. For here we are to observe, that there are but  
two

two forces that act upon her in this point ; the force along the tangent, and the excess of the sun's force above the earth's, at right angles to the former. When forces as 1, 92 and 1, act in contrary directions, the opposite forces on each side, as 1, are extinguished ; and there remains a force as 92 hundred parts of the earth's whole force acting with the tangential force : and the force compounded of these two must necessarily fall between the directions of the two compounding forces ; that is below the tangent, or towards the sun. And her path being once thus bent down, it could never rise again ; the earth's greater velocity there would still leave her more and more in the sun's stronger attraction. For the sun's stronger attraction prevails round the earth on all sides, as is naturally enough represented in the figure : and the earth's velocity is there much greater ; since, from the last quarter of the preceding revolution, to the first of the next, the earth gets before the moon, or she falls behind the earth, the whole length of the diameter of her orbit, or about four hundred and eighty thou-

land miles. (e)—In this case then, the moon should begin from the point of the conjunction, to describe an *ellipfis* about the sun ; and that point should be the *lower apsis* of her orbit : and the circular orbit at that distance should fall within the ellipfis, touching it only in that point. Or if her velocity was less than requisite, to carry her round the sun in a circle at that distance ; that same point should be the *higher apsis* of a less *ellipfis*, in which she should move about the sun ; and this ellipfis should be contained with the circle at that distance. All this the author himself has shewn in the second chapter before that in which he treats of this subject, so that he is strangely inconsistent with himself.

VIII. Now since he allows that the sun's greater force on the moon *would make her indeed abandon the earth*, it is a false pretence to say, her greater velocity *there* prevents this. Neither a greater, nor a less ve-

(e) To an eye placed in the sun, the moon moves really as much slower than the earth, in the interior part of her orbit, as she seems to us then to move quicker than the sun.

locity

locity could prevent her from being carried down towards the sun, and leaving the earth for ever. A greater velocity would carry her without the circular orbit at that distance: but she would begin from that point to move in an *ellipsis* about the sun. And any velocity, how great soever, could never make her mount upward, or hinder the excess of her gravitation towards the sun, to have its full effect. A greater degree of velocity, than what would carry her in an *ellipsis* about the sun, would turn the curve to a *parabola*; and a still greater degree, would carry her off in an *hyperbola*: in either of which cases, she should abandon both the sun and the earth, and move on through the celestial regions. But no degree of velocity possible could make her rise above the tangent, which, in the same point, *touches* all four curves, the *circle*, *ellipsis*, *parabola*, and *hyperbola*. An infinite celerity (so to speak) could only make her move in the tangent itself, but never rise above it.——Let us remember that the velocity of a cannon bullet in an horizontal direction, hinders not its descent by the force of gravity upon it. And tho' the

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velocity

velocity of the ball were ten, or an hundred times greater than what it is, it would still fall through an equal space in equal times, with any of these different velocities: or it would still fall 16,1 feet below the tangent in the first *second* of time, and afterwards the descents would be, as the squares of the times from the beginning.

——And on the other hand, tho' the gravitation on the bullet were but the tenth, or the hundredth part of what it is, that part would have its full effect, as much as the present gravitation has its full effect. In a word, an infinite velocity only, in respect of the gravitating force, could make the bullet move in the direction of the tangent. So little does more, or less tangential velocity hinder the force of gravitation from taking place!

IX. This sets the controverted point in a plain and full light, so that more needed not be said on the subject: yet we may go on to consider the other arguments brought to prove that a weaker force might overcome a stronger. It is said, “ this apprehension  
 “ [that the moon ought necessarily to abandon  
 “ don

“ don the earth, by the stronger force of  
 “ the sun urging her the contrary way] may  
 “ be easily removed, by attending to what  
 “ has been shewn by Sir *Isaac Newton*,  
 “ and is illustrated by *vulgar experiments*,  
 “ concerning the motion of bodies about  
 “ one another, that are all acted upon by  
 “ a third force in the same direction : their  
 “ relative motions not being in the least dis-  
 “ turbed, by this third force, if it act  
 “ equally on them in parallel lines : as the  
 “ relative motions of the ships in a fleet,  
 “ carried away by a current, are no way  
 “ affected by it, if it act equally upon them :  
 “ or as the rotation of a bullet or bomb,  
 “ about its axis, while it is projected in the  
 “ air ; or the figure of a drop of falling rain,  
 “ are not at all affected by the gravity of  
 “ the particles of which they are made up,  
 “ towards the earth.” (f) And a little  
 “ after, it is said, “ by considering this  
 “ path, we shall arrive at the same conclu-  
 “ sions which Sir *Isaac Newton* derived  
 “ more briefly from the *laws of motion* ;  
 “ ghat if the solar action was the same on  
 “ the satellite and on the primary, and in

(f) Page 337.

“ the

“ the same direction, the motion of the  
 “ satellite about the primary, would be the  
 “ same as if the sun were away.” (g)

X. These comparisons are much insisted on, tho’ they are not more to the purpose now than they were several years ago. That of the fleet of ships carried away by the current, comes not up to the case. The earth and moon are not carried away by the action of the sun, as the ships are by the water that supports them. Nor are there two contrary and unequal forces in the current, to carry the ships different ways, as the stronger force of the sun would carry off the moon, from the contrary and weaker force of the earth. The ships partake of the uniform motion of their *place*; so that it is the same thing with respect to their motion whether the water glides all equally the same way, or remains in the same place, like a standing lake: but the *place* of the earth and moon has no motion, except in *De Cartes’s* system of an *universal plenum*. It is elsewhere said, that no experiment or observation shews that there is any *subtile*

(g) Page 339.

*medium*



*medium* in the celestial spaces, from which any resistance to the motions of the heavenly bodies could arise (*b*), therefore there is no subtile matter round the earth and moon, to impress motion on them. Thus the gravitation of the earth and moon towards the sun, is no ways like the water of the current to the ships: the earth and moon do not fall down in the direction of their gravity; the tangential force always prevents that. Or if the ships were towed across the current, by other forces, which hindered them to follow its direction, their relative motions would be very different from what they are, when carried along by the course of the water.—These obvious differences shew plainly, that this vulgar experiment has no similitude to the thing which it is brought to illustrate.—A simile parallel to the present case would be, if there were a great vortex, which carried round several bodies in it, as the planets are carried round in the solar system; and each of these bodies were in the centers of lesser vortices, with other still smaller bodies carried round these; as the secondary planets are carried round their primaries: and lastly, if any of these

smaller bodies come in any part of its circuit, to be without the verge of its particular vortex; then it could no longer be carried round its central body, but be hurried away, by the force of the surrounding great vortex. A figure of this is easily imagined: and the reader will judge whether it hits the case or not.

XI. As to the other two similies of the cannon bullet, and drop of falling rain, I am not able to see how they come near it, or in what respect there is any likeness between, them and the thing to be illustrated by them.——If a child, on being told that all the parts of the earth were attracted or drawn towards the sun; should ask a reason, why then the parts of the earth next to him, did not yield to that force? It might be told him, that they were more strongly attracted the contrary way by the earth itself: just as the parts of a bullet in the air, by their strong attachment to each other, stick fast together without falling down to the ground, by the way. And this, I think, is the only case to which the comparison of the bullet could be applicable; tho' it could give no great  
light

light to the subject. And here the stronger force prevails, contrary to the design of the simile.——Nor does the other comparison of the *drop* of water answer the purpose. The *drop* yields to the force of gravity impelling it and falls to the ground : so do not the earth and moon fall to the sun. Nor are there two contrary attractions here, to draw the parts of the *drop* asunder ; all its parts are impelled downward alike. But if it be suspended, so that the force of gravity acts in opposition to the cohesion between its parts, the figure of the *drop* is first lengthened, and at last it falls down. This is more remarkable in honey when it drops, as its parts have more tenacity than those of water.——Now, the weaker attraction of the moon by the earth, in the present case, is as the looser cohesion between the particles of the *drop* ; and the sun's action on her (stronger here by concession) is as the force of gravity, which separates the parts, of the liquor. So that even according to this comparison, the moon should be separated from the earth, by her stronger gravitation towards the sun. And if she were a fluid body, her figure would  
be

be changed, or drawn out at length, like the drop of water.

XII. As to the argument said to be derived from the *laws of motion*, " That if the  
 " solar action was the same on the satellite,  
 " and on the primary, and in the same di-  
 " rection ; the motion of the satellite a-  
 " bout the primary would be the same as  
 " if the sun was away." If this proved  
 any thing, it would prove a great deal more  
 than the author would have desired it  
 prove ; namely that the moon might move  
 regularly about the earth, tho' her gravi-  
 tation towards the sun were ever so much  
 stronger than her contrary gravitation towards  
 the earth. For there are only two conditions  
 here required. First that the solar action on  
 the earth and moon be the same. And then,  
 that it may be in the same direction. The  
 inequality of the sun and earth's force on  
 the moon is no way regarded. This occa-  
 sioned the extravagant notion mentioned  
 above, that tho' the sun attracted the  
 moon a thousand times more strongly the  
 one way, than the earth does the other,  
 yet her course about the earth might be  
 preserved regular. If she were attracted  
 only

only four times more strongly, or but twice more strongly by the sun, one way, than by the earth the other; no body I think can conceive that her course could be preserved regular, or that she would not yield to the stronger force. Or if this be the *law of motion*, sure I am that men are yet strangers to the nature of motion.——

It is altogether remarkable here, that the greater the quantity of matter in the sun is supposed to be, or the greater his distance is from the earth; the nearer *the point of equal attraction* between them will approach to the earth: and the excess of his force on the moon, above the earth's force on her, will still be the greater. And at the same time, his action on the earth and moon will still approach nearer to an equality, and the direction of it nearer to a parallelism.——

Thus the two conditions insisted on here, are necessarily attended with two other conditions, which shew them absurd; and the more these conditions are supposed to obtain, the more the absurdity is increased. This I had shewed before in the *English Mathematico* (i); which it would have been proper

(i) *Loco citato.*

to have observed, before the same conditions were again insisted on. This shews us that the inequality of the sun and earth's forces upon the moon, was the chief thing to have been considered in this affair. And it is strange enough that the author should have advanced this argument, after owning, that *the moon would indeed abandon the earth*, by the stronger action of the sun upon her, at the conjunction; if her too great velocity *there* did not prevent it.

XIII. And I am afraid that this will be found to be the fault of the author's geometrical propositions; that if they proved any thing, they would prove more than they should. For *the same two conditions* are again repeated more peremptorily, exclusive of any other. It is said, " thus we arrive at  
 " the same conclusion, which Sir *Isaac*  
 " *Newton* more briefly derived from an  
 " analysis of the motions of the satellits:  
 " that while the satellite gravitates towards  
 " the primary, if, at the same time, it be  
 " acted on by the same solar force as the  
 " primary, and with a parallel direction;  
 " it will revolve about the primary, in the  
 " same

" same manner, as if this last was at rest,  
 " and there were no solar action. These  
 " two forces, the gravitation, towards the  
 " primary, and a force equal and parallel  
 " to the gravitation of the primary towards  
 " the sun, *are exactly sufficient* to account  
 " for the compounded motion of the sa-  
 " tellite in its path, however complex a  
 " curved line it may appear to be. Nor  
 " *is there any perturbation of the satellite's*  
 " *motion, but what arises from the inequa-*  
 " *lity of the gravity of the satellite, and of*  
 " *the primary towards the sun, or from*  
 " *their not acting in parallel lines (k).*" This  
 is very exprefs, that no inequality of the sun  
 and earth's action on the moon, could disturb  
 her motion round the earth; if the sun at-  
 tracts the earth and moon equally, and in  
 parallel lines. And, as was observed just  
 now, these two conditions obtain most,  
 when the excess of the sun's force upon  
 the moon, above the earth's force on her,  
 is greatest. So that the greater this excess  
 is supposed to be, the more regularly the  
 moon should revolve about the earth.  
 Which, in effect, is just saying, the more

unequal the contrary forces are, which act upon the moon in the conjunction, the more regularly she will yield to the weaker force. Such untenable principles must make a man inconsistent with himself : and tho' it be no pleasant thing, to mark inconsistencies in any performance ; yet that is not my fault. The reader, no doubt, who has patience enough, will be surprized to see *this excess*, here excluded, again insisted on, in order to explain the motions of all the secondary planets in the solar system. This makes it necessary to transcribe the following passage. It is said,

XIV. “ The force that bends the course  
 “ of a satellite into a curve, when the  
 “ motion is referred to an immoveable  
 “ plane, is, at the conjunction, the difference of its gravity towards the sun,  
 “ and of its gravity towards the primary.  
 “ When the *former* prevails over the *later*,  
 “ the force that bends the course of the  
 “ satellite, tends towards the sun ; consequently the concavity of the path is towards the sun : and *this is the case of*  
 “ *of the moon*, as will appear afterward.  
 “ When the gravity towards the primary  
 “ exceeds



“ exceeds the gravity towards the sun, at  
 “ the conjunction, then the force that  
 “ bends the course of the satellite, tends  
 “ toward the primary, and therefore to-  
 “ wards the opposition of the sun : con-  
 “ sequently the path is there convex towards  
 “ the sun : and this is the case of the sa-  
 “ tellites of Jupiter. When these two forces  
 “ are equal, the path has, at the conjuncti-  
 “ on, what mathematicians call a *point of*  
 “ *reftitude*. In which case however, the  
 “ path is concave towards the sun through-  
 “ out (1).” One knows not well what to  
 make of this : for here the whole course of  
 the secondary planets is made to turn upon  
 the condition, which was before excluded  
 from having any share in the regularity of  
 their motion ; the prevalence, namely, of  
 the sun’s or primary’s force upon them. And  
 it is made the condition of the moon’s path  
 being concave towards the sun, that her  
 gravitation towards him at the conjunction,  
 be greater than towards the earth : and  
 contrarily, it is made the condition of Ju-  
 piter’s satellites having their path convex to-  
 wards the sun at the conjunction, that

their gravitation towards the sun, be less there, than towards the primary. It were easy to prove any thing at this rate. The prevalence of the sun or primary's force upon the satellite, is only considered to answer the author's purpose, and to bend the course of the satellite to, or from the sun. The motion of the moon round the earth is still left in the contradictory terms it was ; that tho' she gravitated a thousand times more towards the sun, than towards the earth, her course round the earth would still be preserved regular. It requires indeed some attention to observe the different purposes, for which these opposite suppositions are made.—From what was shown in No. 7. and 8. it is easy to perceive that of the three cases here laid down, concerning the various prevalence of the sun or primary's force upon the satellite, two are imaginary.. If the sun's force on the satellite at the conjunction, were stronger than the primary's force upon it ; or if the two forces were but equal, the satellite would be carried off from the primary.

XV. In the geometrical propositions, a path is first contrived for the moon, concave towards

towards the sun throughout, and convex towards the earth at the conjunction ; being an *Epicycloid* on a circular base, that should cross the earth's annual orbit about 26 times in the year. The method in contriving this is not quite satisfactory. In the proposition itself, the radius of the circular first base, is to the radius of the circle which revolves upon it : as the periodic time of the earth about the sun, to the time of the synodic revolution of the moon about the earth. But in the demonstration of this first proposition, and in the two other propositions, the first radius : is to the second : as the periodic time of the earth about the sun : to the periodic time of the moon about the earth. These two do not agree. The synodic time of the moon is 2 days and 5 hours longer than the periodic time. In the first proportion, the circumference of the immoveable circle, or base on which the other is supposed to roll round, by a continual application of part to part, contains the circumference of the other 12,36 times ; the circumference being always as the radius. In the second proportion, the greater circumference contains the

less 13,36 times; which is too much. According to the first of these suppositions, the moon will be 12 times in conjunction with the sun, and 0,36 parts of revolution over, while the earth moves once round the sun. In the second supposition, which the demonstration of all three propositions proceeds upon; the moon, in the same time, will be 13 times in conjunction with the sun, and 0,36 parts of a revolution over. For the *point* in the revolving circle, which describes the *Epicycloid*, or path of the moon, must fall 13 times between the sun and earth, while the circle turns 13 times round, and a third of a time more.—This should have been better adjusted, as it gives us a *lunar month* too many in the year.—Then it is shewn how a tangent to any point of this path might be drawn, and what the absolute velocity of any body in that point should be. In the second proposition, the center of curvature in any point of the *Epicycloid*; and the ray of curvature in that point, are determined. All this is laid down, without any regard, either to the force of the sun or of the earth upon the moon.

The

The consideration of the excess of the first above the last, by comparing them together, is past over in silence, for fear of the contradiction arising from the moon's yielding to the weaker force. The main design is to shew the moon's path concave towards the sun, at the conjunction : tho' that cannot be done without incurring the same contradiction, as we shall soon see, when the last proposition is considered : for the great difficulty lies there.

XVI. It is the beauty of the new philosophy, that it accounts for the motions of the heavenly bodies, from natural causes or from the forces that act upon them : this gives satisfaction to a rational enquirer. Formerly men set their imaginations at work, to invent suppositions in order to save appearances ; without considering what forces should move these great bodies in such a manner. Thus the *primum mobile*, and all the heaven of fixt stars, were thought by the ancients, to whirl round the earth in 24 hours. And in the *Tychonic system*, perplexed motions in *different circles* and *epicycles*, were contrived for the planets,

without

without regarding what forces could carry these circles themselves, and the planets round in these circles : as if all this had been to be guided by the *genii*, or *angels* that govern the spheres above. This shewed the fruitfulness of men's invention, but did not hit the truth of the case.——But to return ; in the last proposition, the force of the sun upon the earth and moon, is pretended to be deduced from a proportion laid down in the second proposition. And it all comes to this (as will appear) that the sun attracts the earth and moon equally, and in parallel lines. The right method here, I conceive, had been, to have assumed the forces of the sun and earth upon the moon, according to some particular parallax ; so that the force of the sun upon the moon should have exceeded the force of the earth, upon her ; and from these forces thus assumed to have shewn, that her path is such as was marked for her : as also to have proved, that her too great velocity at the conjunction, prevented her yielding to the sun's stronger force, as was asserted before. I shall consider this particular, which was the whole design of the undertaking, and  
in

in which all the difficulty consists: so much of the author's figure as relates to this, I have drawn, somewhat more justly.

XVII. In this figure, as applicable to the earth and moon,  $A$  is the earth,  $Aa$  the ecliptic, in which the earth moves from  $A$  to  $a$ , according to the order of the signs;  $L$  is the moon,  $Ll$  the path, in which it is pretended the moon moves;  $CLD$  is the orbit she would describe about the earth, if the sun were away, and in which she moves from  $C$  to  $L$ , or from  $c$  to  $l$ , contrary to the motion of the earth.  $S$  is the sun,  $B$  is a point in the ray  $AS$ , to which it is said, in proposition 3, the forces that act on the moon, and make her describe the *epicycloid*, are *always* directed. It is thus determined in the second proposition.  $AS$ , or the periodic time of the earth round the sun : is to  $AE$  the periodic time of the moon round the earth : as the same  $AE$ , or periodic time of the moon, is to  $AB$ .—It is to be observed here, that the three first terms in this proposition, are constant; the periodic time of the

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earth

earth, to wit, round the sun, and the periodic time of the moon round the earth, which is taken twice: therefore the last term  $AB$ , must be an invariable quantity, whether the sun's parallax be great or small. This breeds an error in the author's whole reasoning, concerning the forces that act upon the moon, according to the different parallaxes of the sun. For when he comes to determine these forces, he says, " it appears from what has been demonstrated, " that *the path may be described*, by a force " directed towards the point  $B$ , (which is " given upon the ray  $AS$ , but revolves " along with this ray about  $S$ ) or by any " forces, which compounded together, generate a force tending to  $B$ , and always " proportional to  $LB$ , the distance of the " satellite from  $B$ . Let  $LH$  be equal and " parallel to  $AB$ , and  $ABHL$  shall be " a parallelogram, and the force  $LB$  ( $m$ ) " may be compounded of  $LH$  and  $LA$ : " that is, the force  $LB$  may be the result " of a force  $LH$  acting on the satellite, " equal and parallel to  $AB$ , the gravitati-

( $m$ ) It is  $LK$  in the author's book, but that does not agree with the sense.

" on.



“ on of the *primary* towards the sun, and  
 “ of a force  $LA$ , tending to the primary,  
 “ and equal to the gravity by which the  
 “ satellite would describe the circle  $CLD$   
 “ about the primary, in the same periodic  
 “ time  $t$ , if the sun were away ( $n$ ).” And  
 this is all that is said concerning the forces  
 which act upon the moon, and make her  
 move in the *Epicycloid* before contrived :  
 which just comes to this, that the sun at-  
 tracts the earth and moon equally, and in  
 parallel lines.

XVIII. Now since the only condition  
 of the forces here is, that the sun act upon  
 the earth and moon, *equally, and in parallel*  
*lines*, without any regard to the excess of  
 the sun’s force above the earth’s on the  
 moon ; or to the distance of the sun from  
 the earth, (for  $AB$  is determined from the  
 sun’s periodic time, which is the same,  
 whatever his distance be :) since this is so,  
 I say, if these propositions proved any thing,  
 they would go on to prove, till the absurdity  
 became monstrous, in spite of all endea-  
 vours to restrain them ; that the moon

yielded to the earth's weaker force, tho' the sun attracted her the contrary way, an hundred, or a thousand times more strongly. For the more these conditions obtained, the greater that excess of force would grow; and the absurdity must become intolerable.

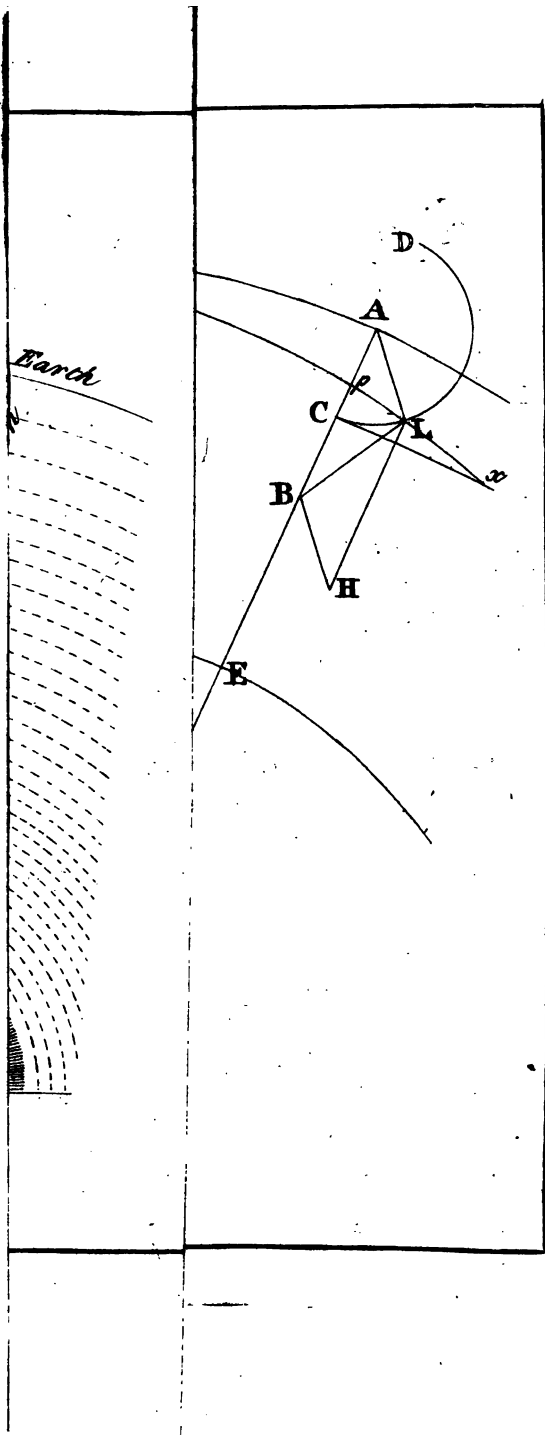
—With respect to this excess of force, the second corollary to the second proposition is remarkable. The collary is, “in the case of the moon,  $t t : T T : : 1 : 178 =$  “  $\frac{1}{178} \times AS$ ; but  $AC$  is about  $\frac{1}{337} \times AS$ ; “ consequently  $AC$  is less than  $AB$ , and “ *the path of the moon is concave towards the sun throughout.*” Here the excess of force is mentioned, with a view only to shew that the moon's path must be concave towards the sun throughout, and to tally with the first of the three cases laid down before, in page 336. It is mentioned only as an excess of lines, not as an excess of forces. And when the forces come to be considered afterward in the third proposition, the absurdity of a weaker force overcoming a stronger, is past over in silence; the excess had already answered the end for which it was intended. It seems strange to me, when a contradiction is objected, that one can get over

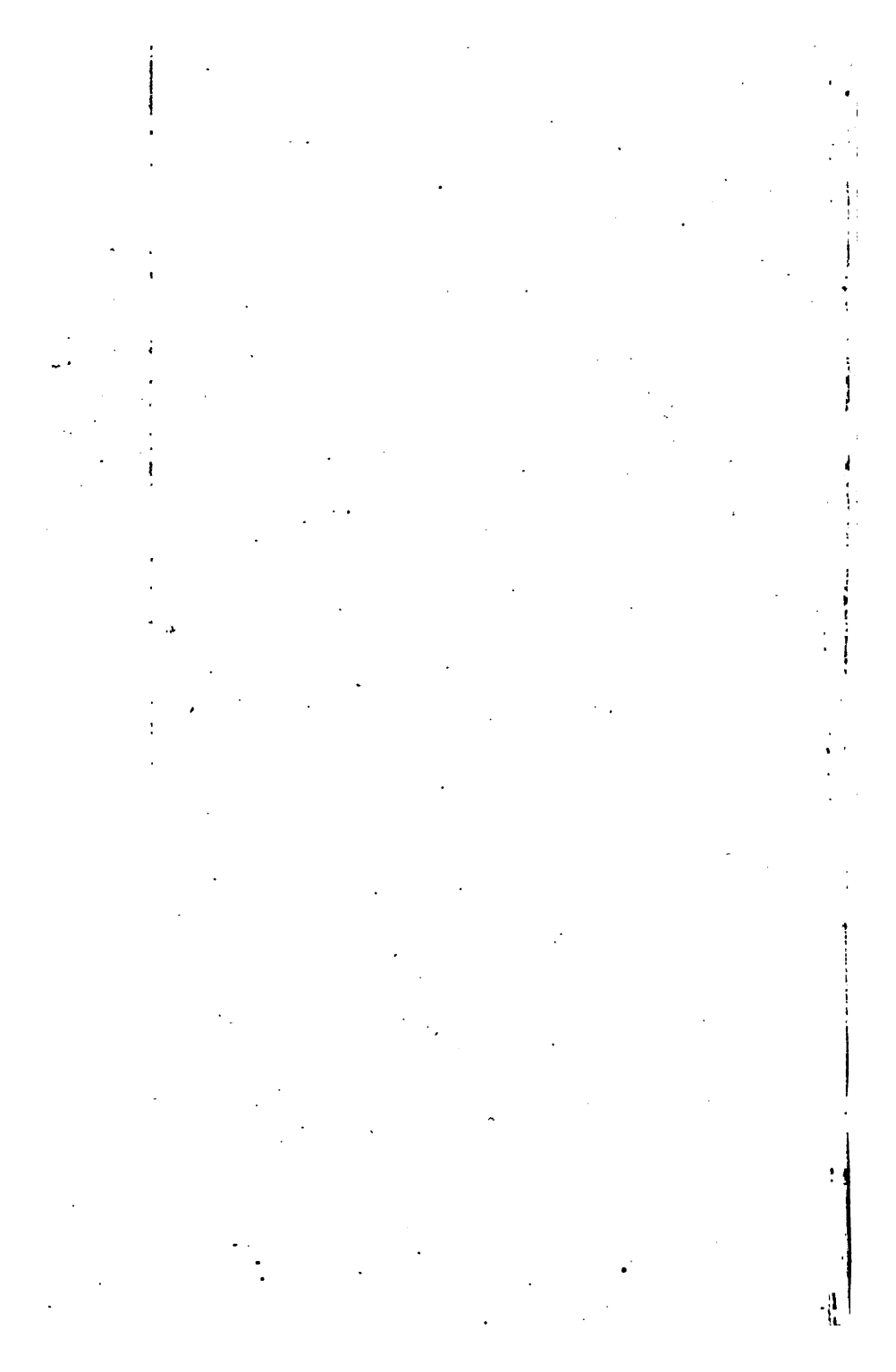
over it so easily, at the expence of truth itself : For if one contradiction could be true, *all truth ceases*. But it should have been observed in this corollary, that  $AB$  is an invariable quantity, and must be greater than  $AC$ , even when the sun's parallax is 26 seconds, or when the sun's force on the moon, is to the earth's force on her, as 1 to 1, 334 (see the annotation to *Mathe*) that is  $AB$  must be greater than  $AC$ , by the author's geometry, when it is less in the nature of things. And the moon's path must be concave towards the sun throughout, even when the earth's force on her is greater than the sun's, contrary to the condition in page 336.

XIX. The original contradiction, of a weaker force overcoming a stronger still remains, after all this demonstration. For taking the parallax of 10 seconds, which this geometry goes upon, when  $L$  coincides with  $C$ , in the conjunction, or when the moon is exactly between the sun and earth; if  $AB$  represented the sun's force on the moon, it should be to  $AC$ , as 1,92 to 1. Whence  $CB$  is nearly equal to  $CA$ , or  $LA$ :  
that

that is, the excess of the sun's force upon the moon, above the earth's force, is nearly equal to the earth's whole force upon her. In which case (as was before said) she is only acted upon by two forces, the force as  $CB$ , urging her towards the sun, and the tangential force as  $Cx$ , acting at right angles to that : for the opposite forces, as  $CA$ , on each side consume one another. This leaves the contradiction just as it was ; since to say that she would rise above the tangent, or not move in a direction between the directions of the two compounding forces, is just saying, when a body is impelled by two forces, it will not move in the diagonal. This is an absurdity too great to be concealed by any apparatus of demonstration, or supported by any authority. On the contrary, if the moon's gravitation towards the earth, makes her fall 16, 1 feet below the tangent of her orbit, in a minute, her gravitation towards the sun in this case would make her descend towards him, nearly as far in the same time. And she must always fall below the tangent to that side, as long as her gravitation towards the sun is any thing greater than her gravitation towards

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towards the earth.—And if the two opposite forces were equal, then her path would indeed have *a point of rectitude*, and the tangential force would only remain : but the earth's quicker motion would soon leave her exposed to the sun's stronger force, and still her course would be bent towards the sun.

XX. Hence therefore in all cases, without exception, a satellite must gravitate more towards its primary than towards the sun, that it may revolve about its primary : and in all parts it must have its path concave towards the primary, and never concave towards the sun at the conjunction. This I think may be represented to the imagination in a sensible manner.—Let us suppose the orbit of the moon to be carried about with the earth in the ecliptic, like a moveable *locus*, of whose motion she partakes ; and that a tangent to the orbit in the conjunction were likewise carried along, or (which is the same thing) always drawn to that point, while the moon moved round the earth as she does now. This tangent would be always perpendicular to a line

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joining the center of the sun, moon, and earth. But the moon could never go below this tangent towards the side of the sun: that would be supposing her to go without her orbit. Therefore her path could never be concave towards the sun in that part. This would be plain to the eye, if the author had drawn his figure to represent the moon in the conjunction: for the tangent would be common both to a circle round the sun at that distance, and to the moon's orbit in that point, and from that point the curves are bent contrary ways. And if the moon's path, by this compound motion, were referred to an immoveable plane, parallel to that of her orbit, but farther from the eye, supposed in the axis of her orbit, and at an infinite distance, as in the orthographic projection of the sphere: I say, if her path were reduced to this immoveable plane, it would form a serpentine line convex to the sun below the ecliptic, and concave towards him (and the earth) above the ecliptic, with a point of contrary flexure, at each crossing of the ecliptic; but nothing like the author's epicycloid. And such a serpentine



tine path, all the satellites of Jupiter and Saturn form; notwithstanding what is said in the first corollary of his second proposition.— If the semidiameter of the moon's orbit be made radius, the distance of her path from the ecliptic, on either side, might be determin'd, by right lines applied perpendicular to the ecliptic, and distances proportional to the times in which she performs any part of her monthly revolution.

XXI. As the moon could not rise up from the conjunction, towards the ecliptic, contrary to the stronger force of the sun; so, if the earth and moon turned round on their common center of gravity, that center would be always in the ecliptic, and the earth, when below it, could not rise upward contrary to the sun's stronger force. If the sun's parallax be 10 seconds, the point of equal attraction between him and the moon would be only eleven semidiameters of the earth distant from her center; and the sun's force on the earth would be 29 times greater than her force upon it. (See the annotation to the *Latin Matho.*) This shews the impossibility of the earth's mounting